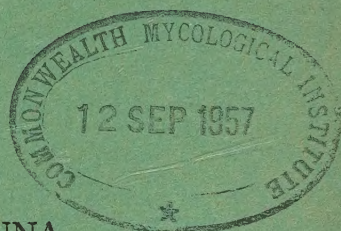




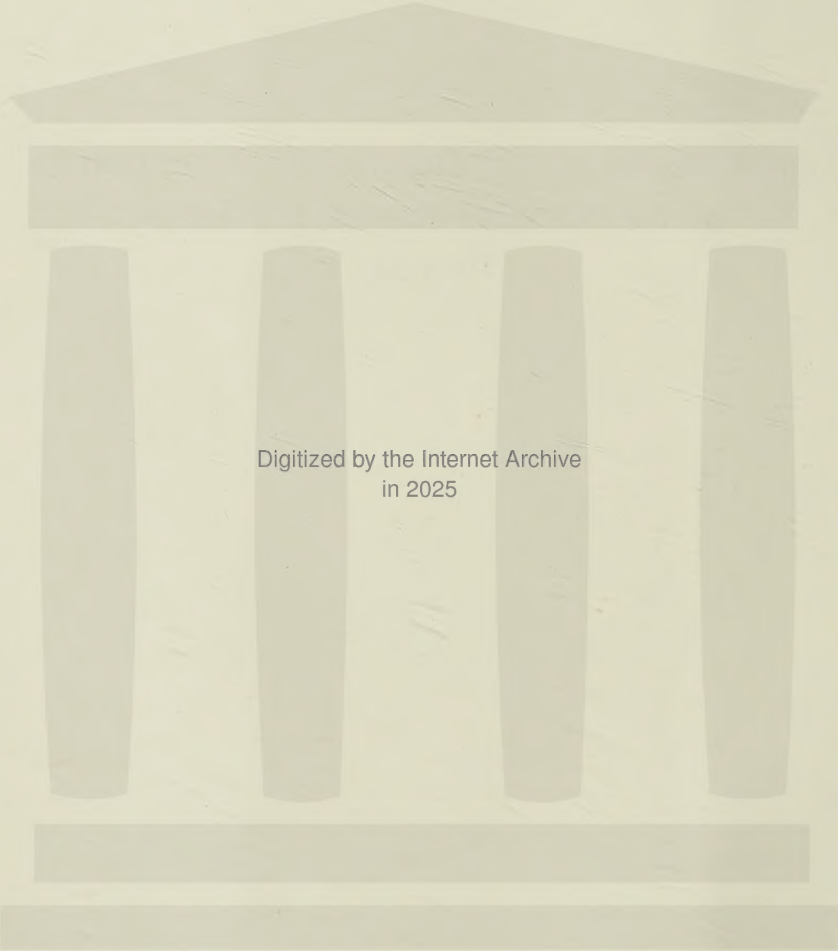
NORTHERN REGION OF NIGERIA

**Annual Report on the Department
of Agriculture of the Northern
Region of Nigeria
1953-54**



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of the Northern Region of Nigeria
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FOREWORD

by

THE HONOURABLE P. S. ACHIMUGU, O.B.E.,
Minister of Natural Resources,
Northern Region

Agriculture will continue to form the lynch-pin of our Northern Regional economy for years to come. This report shows some aspects of the various ways in which the Department of Agriculture is stimulating production and improving techniques. I congratulate the Director and his officers on another year of solid progress. I am particularly pleased that the research activities of the Department are being strengthened and that the research knowledge gained is being continuously tested in the field of agricultural extension. The watch-word for the Department of Agriculture is now to help the farmer to help himself. Improved equipment and methods can go far to take the drudgery out of farming but there will be no real rural betterment without self-help.

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ANNUAL REPORT ON THE DEPARTMENT OF AGRICULTURE OF THE NORTHERN REGION OF NIGERIA, 1953-54

1. *Staff and General.*—The year under review showed a net increase of four Senior Service Officers but the number of trained Agricultural Officers decreased by one. In the Junior Service the picture is a little brighter as there was a net increase of forty-three, but when it is considered that in the past four years an average of 26 students have successfully passed their Agricultural Assistants' course examinations it will be appreciated that the increase is not as great as it might have been hoped. There is no doubt that, for a country the size of the Northern Region and one that is developing so rapidly, the present staff is deplorably inadequate.

A summary of the establishment apart from staff posts is given below:—

<i>Post</i>	<i>Establishment</i>	<i>No. 1-4-53</i>	<i>No. 31-3-54</i>	<i>Vacancies</i>
SENIOR SERVICE				
Senior Agricultural Officers ...	10	6	4	6
Agricultural Officers ...	27	12	13	14
Agricultural Superintendents ...	11	11	12*	—
Agricultural Development Officers	17	13	5	12
Irrigation Engineers ...	7	7	7	—
Agricultural Engineers ...	3	2	3	—
Mechanic Demonstrators ...	10	8	9	1
Specialist Officers ...	6	3	5	1
JUNIOR SERVICE				
Assistant Agricultural Officers, Grade I ...	6	4	9†	—
Assistant Agricultural Officers, Grades II and III ...	23	9	19	4
Senior Agricultural Assistants ...	9	6	9	—
Agricultural Assistants, Grade I ...	26	23	12	14
Agricultural Assistants, Grades II and III ...	194	141	167	27
Irrigation Surveyors, Grades II and III ...	16	2	7	9
Field Overseers, Grades I and II ...	141	128	121	20
Irrigation Overseers, Grades I and II ...	40	15	27	13

* Over establishment offset against Agricultural Officer's vacancy.

† Three Supernumerary.

2. *Organisation.*—From the beginning of the year until 7th July the work of the Department was directed by Mr J. D. Brown who proceeded on retirement leave after approximately twenty-nine years service in Nigeria. Mr M. W. Gibbon was Acting Director until 14th February when Mr P. C. Chambers assumed the post of Director of Agriculture, Northern Region.

The Production Division financed by the Northern Regional Production Development Board, but directed by the Department of Agriculture, may now be considered an essential part of the Department because, without the help of the Production Officers, the present agricultural extension programme could not be undertaken. The number of Production Officers increased by eleven, making a total of thirty-five.

There has been no major change in the organisation of the Department since my last annual report.

3. *The Season*.—In most areas the rainfall was about average but a combination of factors tended to produce low corn yields. In most places the distribution of the rains was uneven. Heavy rains and the fast of Ramadan retarded the first weeding of the millet crop which received a severe set-back from which it never properly recovered. The early cessation of the rains was detrimental to the guineacorn crop. Corn reserves are definitely less than last year. The yam crop was reported to be good and yields of other food crops were average or a little below.

Typical rainfall records are given below:—

NORTHERN BELT

<i>Months</i>	KANO		SAMARU (ZARIA)		GUSAU		BORNU (MAIDUGURI)	
	1953	<i>Average</i> 27 years	1953	<i>Average</i> 30 years	1953	<i>Average</i> 20 years	1953	<i>Average</i> 37 years
January ...	—	—	—	—	—	—	—	0.01
February ...	—	0.01	0.33	0.05	0.39	0.05	—	—
March ...	—	0.08	—	0.30	0.19	0.74	—	0.01
April ...	—	0.39	—	1.18	—	0.76	—	0.24
May ...	5.22	2.66	10.07	5.11	6.23	3.49	2.18	1.61
June ...	6.51	4.15	5.97	6.41	7.09	4.81	3.99	2.68
July ...	6.53	8.19	11.56	8.92	11.39	7.53	12.91	6.98
August ...	10.39	11.82	8.74	11.36	9.01	12.34	7.56	8.77
September ...	3.47	5.45	8.92	8.65	9.69	7.18	4.53	4.23
October ...	0.02	0.56	0.30	1.40	—	1.03	—	0.73
November ...	—	—	—	0.03	—	—	—	0.01
December ...	—	—	—	0.01	—	—	—	—
	32.14	33.31	45.89	43.42	43.99	37.93	31.17	25.27

SOUTHERN BELT

<i>Months</i>	PLATEAU (RIYOM)		NIGER (BIDA)		BENUE (YANDEV)		ILORIN	
	1953	<i>Average</i> 12 years	1953	<i>Average</i> 18 years	1953	<i>Average</i> 27 years	1953	<i>Average</i> 49 years
January ...	—	0.03	—	—	0.13	0.29	—	0.27
February ...	1.48	0.42	0.70	0.27	1.26	0.72	0.85	0.65
March ...	2.07	1.05	0.39	1.21	2.48	1.36	4.28	2.19
April ...	1.64	3.51	0.29	2.32	1.28	3.91	2.54	4.06
May ...	4.82	7.44	6.50	6.11	8.50	7.16	10.60	6.70
June ...	6.87	8.46	5.87	6.90	5.02	7.70	10.35	7.65
July ...	9.65	9.84	12.77	8.10	11.61	5.50	8.91	5.59
August ...	13.58	13.33	6.09	8.41	2.17	6.56	1.39	4.84
September ...	8.10	9.73	7.74	9.45	7.47	10.77	10.00	9.59
October ...	0.70	2.73	2.10	3.83	4.33	8.93	8.03	6.84
November ...	—	0.14	—	0.34	0.14	0.55	—	1.16
December ...	—	0.11	—	—	—	0.16	0.13	0.31
	48.91	56.79	42.45	46.94	44.39	53.61	57.08	49.85

4. *Quantity and Value of Export Crops.*—Quantity and value to the producer of the principal Export crops for the 1952-53 and 1953-54 seasons:—

Crop	Tonnage purchased for export		Value to the Producer	
	1952-53	1953-54	1952-53	1953-54
Groundnuts	430,696	424,662	£ 15,504,056	£ 15,287,832
Seed-cotton	48,244	71,876	2,653,819	3,966,035
Benniseed	13,501	13,447	486,036	484,092
Soya-beans	3,899	8,731	77,980	174,620
			£ 18,721,891	£ 19,912,579

5. *Shika Stock Farm.*—Despite the fact that the incidence of Trypanosomiasis was heavy the average herd lactation figures increased slightly; seventy-three white Fulani Cows gave an average of 2,639 lbs, an increase over last year of sixty-three lbs. and the Sokoto herd of thirty-two cows averaged 2,771 lbs representing an average increase of 38.4 lbs. The numbers of lactations of 3,200 lbs or over were virtually the same, White Fulani twenty-four, compared to twenty-five, and Sokoto twelve, compared to thirteen last year. The highest recorded lactation for the year was 4,654½ lbs given by White Fulani Cow 578 in her 4th lactation, while in 1952-53 four cows surpassed this figure, the highest lactation being 5,722 lbs given by White Fulani Cow No. 386 in her 10th lactation.

There was a serious increase in the incidence of G. Morsitans during the year and this accounted for the death of twenty-two head of cattle from Trypanosomiasis. A bush clearing scheme was begun in January to clear the farm and surrounds of tsetse. By the end of the year 120 acres was cleared which produced 674 cords of fire wood.

The policy of keeping the Shika Piggery as a centre for good breeding stock remained unchanged. The percentage mortality during the year decreased from 34.17 per cent to 31.4 per cent. This is probably due to the introduction of new imported blood.

The following table is of interest and tends to show that too much inbreeding may be responsible for the low numbers of weaned pigs. As the management conditions were fairly uniform for each of the groups the different performances may well be due to the different breeding history of each group. For an example, the younger pure bred sows might be expected to be more highly inbred, leading to a possible drop in the average number weaned. The reverse may be true of the Non-Pure Bred groups.

Summary of Herd Records

Group	No. Sows	No. Litters	Av. No Born per Litter	Av. No weighed per Litter	Av. No weaned per Litter	Av. Birth weighed (lbs)
Old Pure Bred Sows (Farrowing 1953-54 by sows with previous farrowings) ...	12	18	10.55	8.77	6.66	2.96
Young Pure Bred sows (1st Farrowing 1953-54) ...	7	12	8.58	6.89	5.66	2.71
Old Non-Pure Bred Sows ...	27	44	11.47	9.31	7.22	2.59
Young Non-Pure Bred Sows	31	39	10.07	8.79	8.00	2.71

6. *Shuwa and Adamawa Herds*.—Selective breeding continued with the Shuwa herd which now totals 140 head. Nineteen cows completed lactations and the herd average is the highest that has been recorded for Nigerian cattle, standing at 3,800.8 lbs. The highest yield during the year was 5,747 lbs and there were fourteen lactations that topped the 3,200 lbs mark. Cow number 111 gave the best yield of 13.4 lbs per day between calves and her total lactation was 5,633 lbs. The work with the Adamawa herd on the other hand has not been so promising, the highest yield was 3,588 lbs and only one cow gave a lactation greater than 3,200 lbs. The herd average based on nineteen cows which completed lactations during the year was 1,699 lbs.

7. *Daudawa Beef Herd*.—The year's work was very disappointing owing to the heavy losses from disease. Fifty-six deaths occurred, exceeding births by two. Constant attention was given by officers of the Veterinary Department to diagnosing the cause of these losses, but no common factor could be traced.

8. *Cattle in Tsetse Country*.—The N'Dama multiplication herd at Ra'av in Benue numbers fourty head compared to thirty-six last year. It has been demonstrated that these cattle cannot thrive on the rough range conditions with gamba grass (*Andropogon* spp.) predominant. Thirteen deaths were recorded mainly attributed to trypanosomiasis but aggravated by semi-starvation. The herd is now being kept under less severe conditions and grazing is being supplemented by concentrates when necessary.

Trials in the use of dwarf shorthorn and Ndama cross-bred bulls as pack and draught animals, have been made, but the general results to date are unsatisfactory.

The issue on loan of Ndama bulls to farmers with dwarf cattle is popular in Benue, Kabba and Ilorin. Farmers declare themselves pleased with the progeny.

9. *Cattle Multiplication Centres*.—Eleven Cattle Multiplication Centres have been built or are nearing completion, in addition to the Ndama cattle scheme mentioned above. The distribution is Bauchi two, Bornu One, Kano two, Katsina two, Sokoto three, Zaria one. Of these six are in operation but no issues of stock have yet been made. Each centre is being supervised by a Production Officer, and consists of twenty or more cows mated to improved bulls, with their followers, kept under conditions approximating to those that might be expected when they reach the hands of the best of the farmers. Lactation records are kept and continuous selection will be practised.

10. *Mixed Farming*.—Fewer farmers were started and more failures were recorded than in the previous year. This does not mean that mixed farming is becoming unpopular but reflects the effects of the policy of consolidation and larger minimum acreage being required. Closer supervision by Production Officers disclosed that many people on the books were no longer operating.

TABLE SHOWING THE PROGRESS IN THE NUMBERS OF
PRACTISING MIXED FARMERS DURING THE LAST FIVE YEARS

Year						No. Started During the Year	Failures During the Year	Total At the end of Year
1949 ...	...	...	...	...	...	1,342	299	5,763
1950 ...	...	...	...	...	...	1,577	288	7,052
1951 ...	...	...	...	...	...	2,306	517	8,841
1952 ...	...	...	...	...	...	2,869	766	10,943
1953 ...	...	...	...	...	...	1,688	867	11,625

The percentage losses of mixed farmers' cattle remained about the same as in previous years 6.9 per cent in 1953 compared to 7.1 per cent in 1952. The two major diseases are Trypanosomiasis representing 18 per cent and Streptothricosis 11 per cent of the total losses respectively.

11. *Poultry*.—During the year the poultry breeding centre at Riyom was cleared of all stock and rested for 6 months to eradicate the streptococca infection which had gained a strong hold on it. At the same time provincial stations selected pens of native hens with the object of crossing them with pure bred cocks and distributing the half-bred progeny.

12. *Agricultural Shows*.—Thirty-four shows were held in the Region this year. There is no doubt that these shows are gaining in popularity and importance. The shows were well attended and again the stock classes were generally of a high standard. Unfortunately Daudawa Show had to be cancelled owing to a suspected outbreak of pleuro-pneumonia. A travelling exhibit organised by the Northern Research Station visited fourteen shows, the maximum possible to fit in with the intensive programme. Special acknowledgement should be made to the various commercial firms, who have aided the mounting success of these shows by arranging exhibits and particularly for their generosity in donating valuable prizes.

13. *Agricultural Training*.—The new buildings for the School of Agriculture Samaru, were officially, opened by the Minister for Natural Resources, Northern Region, in January 1954. A detailed report on the activities of the School is attached as an appendix.

During the year twenty-six elementary school-boys successfully completed their course of training at the N.A. Farm School, Kafinsoli under an Agricultural Assistant, Grade III.

A total of eight N.A. Mallams and staff of the Shendam Resettlement Scheme Plateau Province, were given a short course on elementary soil conservation work.

14. *Fertiliser*.—The Fertiliser Scheme, financed by Northern Regional Production Development Board and involving the purchase, transport and distribution of super-phosphate, was taken over by the Agricultural Department on 1st April, 1953. It had previously been decided that free issues should cease during the year and that the fertiliser should be sold on its merits. The methods adopted have been the planting of a number of Demonstration Plots in central positions and by intensive touring, involving propaganda and personal demonstration of the method of using fertiliser.

The response has been a mixed one. In certain areas particularly in North West Katsina, where land-hunger is acute, farmers have appreciated the value of super-phosphate and are making full use of it. In other areas the attitude of farmers varies from one of apathy to one of definite hostility. The reasons for this appear to be threefold; firstly the inborn antipathy natural to a peasant farmer to any new methods; secondly the hostility built up in some areas in the past by over zealous propaganda directed at the farmers; and thirdly the actual labour involved in applying and the occasional burning of seedlings due to faulty application. Reports indicate that slow but steady progress is being made in selling fertilizer for the 1954 planting season and that the more intelligent farmers are learning to appreciate the advantages that super-phosphate has to offer.

FREE ISSUES AND SALES 1950-53

Year							Free Issues	Sales ($\frac{1}{2}$ cwt bags)
1950	...	...	...	...	...	...	30,000	—
1951	...	...	...	...	...	...	67,000	25,000
1952	...	...	...	...	...	...	32,000	22,000
1953	...	...	...	...	...	...	100	44,000

Of the above figure of 44,000 bags sold in 1953 about one half was sold before this Department took over on 1st April 1953 and it is possible that some of it may refer to sales in the previous season. Distribution of sales by Provinces is shown below:—

Provinces							1951	Bags Sold 1952	1953
Adamawa	...	...	...	...	...	...	205	200	240
Bauchi	...	...	...	...	...	...	2,245	4,381	4,901
Bornu	...	...	...	...	...	...	3,375	3,160	1,374
Kano	...	...	...	...	...	...	2,348	3,815	3,621
Katsina	...	...	...	...	...	...	581	2,926	14,998
Sokoto	...	...	...	...	...	...	15,851	7,600	18,933
Zaria	...	...	...	...	...	...	344	1	6
Niger	...	...	...	...	...	...	—	—	120
							24,949	22,083	44,193

15. *Soil Conservation*.—The Badume Reclamation Scheme, Kano Province, mentioned in last year's report has shown great promise, so much so that Kano N.A. have agreed to declare it a N.A. Resettlement Area and to provide funds for fencing to exclude all grazing. Work has continued on contouring the Kiru Settlement Scheme and results to date have been good.

At Langtang in Plateau Province the second pilot scheme of 500 acres was completed in 1953. The local farmers have been impressed by the work and have shown a spirit of enthusiasm and co-operation. At Sabon Gida in the Shendam Settlement over 100 miles of graded grass strips were made.

16. *Irrigation*.—Teams of Irrigation Engineers are now working in Niger, Sokoto and Bornu Provinces.

In Sokoto ten Village Projects were under construction during the year and of these seven were completed.

In Niger Province all the main Irrigation works at Edozhigi-Wuya have been completed as far as can be done until the Flood Bank is finished. This has again been delayed through breakdown of heavy equipment and non-availability of spares. The scheme has worked satisfactorily and the planted acreage increased by about 400 acres. At Badeggi the Headworks on the Musa River were put into operation from mid-July and diverted water through the Irrigation Channels.

Preparations were made for starting work on the Wulgo Irrigation Scheme on Lake Chad in Bornu Province.

The Sokoto Training School closed down temporarily in February 1954 as it has now turned out sufficient field staff for present requirements

17. *Mechanical Cultivation*.—The Engineering Branch continues to extend its scope and to experiment with a view to finding suitable equipment for local conditions.

Pilot schemes to investigate the economics of mechanical cultivation of swamps for rice growing have generally proved successful and farmers appear to be pleased with the profits they are making.

Mechanical cultivation of uplands still remains problematical. Of the three Tractor Farms, one at Badeggi was closed down as it proved impossible to make a profit. On the M'batie Farm in Benue Province progress was made in further mechanising the cultivation of yams and benniseed but nevertheless the costs of cultivations are still too high to be economical. The Daudawa farm of 150 acres showed a gross profit of £300 which was derived mainly from the 60 acres of cotton. The cost of skilled supervision was not debited in this instance, so that a true economic return is not yet in sight.

The Tractor Hiring Units at Kano and Samaru have not yet developed any great degree of popularity among farmers. During the early months of 1954 a team headed by an Agricultural Engineer and a Production Officer started a tour doing contract ploughing, mainly of swamps, in Zaria Province. The response from the farmers was greater than had been met previously.

18. *Settlements*.—The season has been a successful one and all settlements have shown steady progress. In particular the scheme financed and operated by the Northern Regional Production Development Board in the Lowlands of Plateau Province, known as the Shedam Settlement Scheme, has made a considerable advance. Graded grass strips have been introduced and these appear to have prevented further wash. The Kontagora Land Settlement Scheme (N.R.P.D.B.) in Niger Province which now numbers 10 hamlets each of 20 families with 2 hamlets under construction, has had a satisfactory season. Cattle losses have been greatly reduced by giving regular injections of antrycide Pro-salt.

The Kiru Resettlement Scheme in Kano Province, financed by the Kano N.A., now in its second year, has progressed rapidly. There are 40 settlers working as mixed farmers on 40 acre plots. Pilot schemes at Galembi, Bauchi, at Muna, Bornu, at Shanga, Sokoto and at Sagawa, Katsina are all going forward steadily and are now in their second year. Each scheme started with 4 mixed farming settlers on 40 acre plots. Contouring was carried out before cropping began. The majority of the Settlers have had a successful year and their fortunes are being watched with interest by other farmers in the neighbourhood.

19. *Groundnuts*.—Reports indicate that a slightly larger acreage was planted this year but the total crop was somewhat smaller, Rosette disease was very prevalent, especially in the Riverain Provinces where heavy losses were incurred. Further, the early cessation of the rains reduced the yield from late-planted crops. The Northern Research Station is trying out Rosette resistant or tolerant varieties. Introductions of a variety from Tanganyika said to have considerable resistance to the disease, under certain conditions, is being obtained in quantity. Comparative figures of purchases for export are as follows;—

<i>Province</i>						1951-52 (Tons)	1952-53 (Tons)	1953-54 (Tons)
Kano	...	...	...	...	...	220,934	217,982	223,054
Katsina	...	...	...	...	...	63,727	66,815	59,084
Sokoto	...	...	...	...	...	42,610	48,199	46,893
Bornu	...	...	...	...	...	48,215	51,002	62,071
Bauchi	...	...	...	...	...	17,964	16,741	9,772
Adamawa	...	...	...	...	...	14,219	15,717	11,599
Zaria	...	...	...	...	...	5,300	7,816	6,171
Plateau	...	...	...	...	...	—	4,029	4,242
Other Provinces	...	...	...	...	...	5,286	2,395	1,726
Total						418,255	430,696	424,612

20. *Cotton*.—The multiplication of the Samaru-bred strain of Allen cotton seed, 26 C, reached such a stage that it was possible to issue it to all growing areas other than those riverain areas where Benue Ishan ungraded is grown.

<i>Province</i>						<i>Cotton Seed Distribution in Tons</i>				
						1949	1950	1951	1952	1953
Adamawa	...	...	...	...	...	17	22	31	100	338½
Bauchi	...	...	...	...	...	442	550	867	1,208	1,403
Benue	...	...	...	...	...	40	60	30	42	52
Bornu	...	...	...	...	...	21	24	32	78½	130
Ilorin	...	...	...	...	...	—	—	—	1	7
Kano	...	...	...	...	...	388	498	585	747	785
Katsina	...	...	...	...	...	2,666	3,315	3,828	4,224½	4,138
Niger	...	...	...	...	...	476	539	610	628	678
Plateau	...	...	...	...	...	105	103	124	139½	227
Sokoto	...	...	...	...	...	2,095½	2,856	3,358	3,910½	3,876
Zaria	...	...	...	...	...	1,325½	1,508	1,622	1,845½	1,954
Total						7,576	9,475	11,087	12,924½	13,588½

This season produced a record crop, partly due to increased acreage and partly due to the intensive propaganda which has resulted in many farmers planting early. This season has provided a good object lesson as early crops did very well while late crops were affected by the early onset of the harmattan. Figures for 1953 are those gazetted up to 29th April, 1954 and are not the final figures.

<i>Purchases in Tons of Seed Cotton</i>					
1948	1949	1950	1951	1952	1953
25,316	31,417	40,862	60,748	48,244	71,876

The improved strain 26C/479-25, which has been developed and tested over a number of years has given good results and it is intended to plant several acres of reselected seed for further multiplication.

Entomological records from outstations indicated that there was no major change in the incidence of cotton pests.

Insecticide trials were carried out at three stations, but no marked increase in yields were produced. At Samaru, however, where mirids were controlled by weekly applications of D.D.T., there was a definite alteration in the timing of the harvest, the yields of early pickings on plots where mirids were controlled being higher than similar pickings on control plots.

21. *Sugar*.—Red Rot disease continues to spread and is now prevalent in all the main cane growing areas but the virulence of the attack this year appears to be slackening. The work on the selection of Red Rot resistant varieties at Samaru and Maigana continues.

The loss caused by Red Rot in the previous year has resulted in a decreased acreage of cane and the subsequent reduction in the output of brown sugar.

	1951		1952		1953	
<i>Province</i>	<i>Crushers Operating</i>	<i>Estimated Output in tons</i>	<i>Crushers Operating</i>	<i>Estimated Output in tons</i>	<i>Crushers Operating</i>	<i>Estimated Output in tons</i>
Adamawa ...	17	75	18	120	20	130
Bauchi ...	18	120	21	150	32	250
Benue ...	—	—	1	$\frac{1}{2}$	1	$\frac{1}{2}$
Bornu ...	—	—	1	$\frac{1}{2}$	1	$\frac{1}{2}$
Kano ...	124	1,200	180	1,500	141	1,080
Katsina ...	113	1,940	95	1,425	49	250
Plateau ...	—	—	—	—	1	2
Sokoto ...	87	539	108	837	128	930
Zaria ...	297	2,970	238	2,800	190	1,600
Total ...	656	6,744	662	6,833	563	4,243

22. *Virginia Tobacco*.—Increased acreages are reported in many Provinces, particularly as a dry season crop. In Sokoto Emirate 233 nursery beds were sown capable of supplying plants for more than 100 acres dry-season tobacco. These beds have been less subject to disease and attacks from pest than those laid down for wet season cropping.

Final figures of purchases are not yet available but indications are that the total may be somewhat less than last year.

Variety trials continue at Gusau and at Samaru where unfortunately a number of varieties were lost through "damping off".

23. *Soya Beans*.—1953 has shown a renewed interest in the production of Soya Beans although the price still compares unfavourably with that of Benniseed. In Benue the crop was grown extensively whereas previously it was confined to Tiv Division. In the Abuja Division of Niger Province the increase is most marked, purchases of sixteen, twenty-eight and eighty-four tons respectively in the 1951-52, 1952-53, 1953-54 seasons were recorded.

Total purchases for the Region are given below:—

Year							Purchases for Export (Tons)	Price per Ton £
1950-51	...	...	...	...	...	...	3,510	19
1951-52	...	...	...	...	...	...	8,035	20
1952-53	...	...	...	...	...	...	3,892	20
1953-54	...	...	...	...	...	...	8,731	20

24. *Ginger*.—Although the Kachia Ginger Market was discontinued this year, and no market was gazetted, there was no appreciable decrease in cultivation in Southern Zaria and the whole crop was absorbed in local markets or by buyers for export. In the lowlands in Plateau Province the cultivation of ginger is increasing.

25. *Benniseed*.—The 1953 season was generally not a good one for benniseed and yields were low. It remains, however, a popular and profitable crop.

The selection trials which commenced at Yandev in 1949 have reached a stage where some of the more promising strains have been issued for multiplication.

Figures for purchases over the last four years are given below:—

Year							Purchases for Export (Tons)	Price per Ton £
1950-51	...	...	...	...	...	...	9,188	19-20
1951-52	...	...	...	...	...	...	10,387	32
1952-53	...	...	...	...	...	...	13,375	36
1953-54	...	...	...	...	...	...	13,447	36

26. *Rice*.—In general yields were slightly below normal. The value of controlled irrigation was demonstrated to, and appreciated by the people of Bida who were able to harvest a good crop of rice where previously it would have been poor.

The Shemanker and Jahun Mechanical Rice Cultivation Schemes had a successful season. In Sokoto early floods caused considerable damage and farmers abandoned their land, but later a volunteer crop, estimated as three-quarters as good as a normal planted one, was harvested and consequently a fair season was recorded.

Rice is gaining in popularity and greater acreages are being grown especially in Bornu and Southern and central Tiv in Benue Province. The most popular and all round variety is G 79 and in most rice growing provinces schemes have been organised for the increased multiplication and distribution of pure seed.

27. *Oil Palms*.—The Oil Palm Industry in Igala Division of Kabba Province has shown marked progress in the last two years. Three pioneer oil mills financed by Northern Regional Production Development Board are operating and three more have been approved. Near to each mill Oil Palm Plantations are being established and planted with improved selected seedlings. The target for the division is 1,000 acres. 15,000 seedlings were planted during the year. Figures received from the Department of Marketing and Exports show the quantity of graded produce from the Northern Region for the last three seasons to be as follows:—

						1951-52	1952-53	1953-54
Palm Kernels, Tons	...	...	...	...	...	7,910	10,113	10,294
Palm Oil, Tons	...	...	...	...	...	340	1,419	2,086

In Benue there is an increased demand for improved oil palms. The supplies are restricted by the difficulty of obtaining the necessary germinated seeds which have to be imported from either the Western or Eastern Regions. 2,000 seedlings were sold to private farmers in Idoma Division. In Niger Province 4,000 improved seedlings were distributed to various Native Authorities.

In Southern Division of Plateau three plantations are being established and over 2,000 seedlings were transplanted during the year from the Nurseries, in addition three new village nurseries were started.

28. *Fruit Trees*.—The demand for fruit trees continues to exceed the supply. It is estimated that some 55,000 trees of all kinds were distributed during 1953. The chief demand is for sweet orange and mango. In Bornu fruit farming is expanding rapidly and 40,000 trees were distributed in this Province during the year.

29. *School of Agriculture: Samaru*.—The main event of the year was the completion of the building of new class-rooms, laboratories, assembly hall and offices of which the lay-out and dimensions are truly suited to their functions.

More staff has been devoted to training and the standards raised. The training course for Agricultural Assistants has been shortened from three to two years. Preparations are being made to give the best of these Assistants on their first year's showing an extended course of a further two years to fit them for the Assistant Agricultural Officer grade. In addition there is a Junior course of eleven months for selected Native Administration Assistants. Greater emphasis has been placed on practical work.

For the first time it has been possible to recruit a full class from the Northern Region, reflecting the greater output from the Middle and Secondary Schools. In all fifty-eight students were selected for entry. A table showing the intake and output of the school since its inception in 1932 is given as an appendix.

30. *Northern Research Station: Samaru*.—The development of the research organisation at Samaru has again made progress, particularly in a marked improvement in the Senior Service Staff position. During the year a second Botanist arrived, who has taken over work on the cereal crops and also some plant pathology work, and more recently a third officer added to the Botany section has taken over the groundnut work. Finally the addition of a Laboratory Superintendent working mainly with the Botany section has brought this most important branch up to a strength never before achieved.

The development of the research organisation, which has hitherto been of a piecemeal nature, is put on a much more satisfactory basis by the recent decision by the Regional Government and the Cotton and Groundnut Boards to take joint financial responsibility for a comprehensive scheme which will involve the expenditure during the next ten years of some £3,000,000. This scheme, which is of a magnitude in keeping with the importance of agriculture in the economy of the region, makes provision for a greatly increased programme of plant breeding, investigations of pests and diseases, intensified work on pasture and grasslands, and on chemical and agronomic problems. A soil survey team for the Region is included, and much more attention will be given to the peculiar problems of the Middle Belt than has previously been possible. Although financed to the extent of 80 per cent by the two Boards, the scheme is by no means confined to the cotton and groundnut crops; all crops will receive the attention demanded for the overall improvement of the farming systems of the Region.

Agonomy Section.—Eight new assistants were posted to the section for training in experimental technique. Two resigned during the year but the remaining six have been posted to the more important stations to take charge of the experimental work. The section continued the general supervision of field trials at Samaru and outstations, and the analysis and summarising of the results. During the year the summarising and card indexing of all past experiments was completed.

Botany Section.—The new pathology laboratory and office block was completed early in the year and a further extension almost completed by the end of the year. This includes a physiological laboratory and further offices, work rooms and stores. Equipment of the new laboratories is by no means complete, but progress has been on the whole satisfactory.

New introductions included 21 varieties of groundnut and 14 of sugar cane; the latter are particularly welcome as providing a possible source of material resistant to Red Rot disease which has caused considerable havoc in the cane fields in the past few years.

A number of recent groundnut imports have now shown sufficient promise to justify extensive trials at outstations. The most pressing problem with this crop, at least as far as the Middle Belt is concerned, is the virus disease Rosette, which was devastatingly prevalent in 1953. A search for resistant or tolerant varieties has been started, and a variety from Tanganyika, said to have considerable resistance to this disease under certain conditions, is being obtained in quantity.

The crossing and selection of guineacorn varieties was continued and some preliminary work was done on guineacorn diseases. The section made itself responsible for demonstrating the use of copper carbonate seed treatment against Covered Smut of guineacorn at the Agricultural shows in the Region, and ensured that supplies of this chemical were available for distribution to interested farmers.

Chemistry Section.—In the series of trials incorporating farmyard manure with nitrogenous, phosphatic and potassic fertilisers, possible detrimental effects from repeated heavy dressings of superphosphate appeared in two cases; the stations concerned being Kano and Yandev. This effect, which is what we have been looking out for, has not yet appeared in any of the other five stations, and it will receive further investigation in the coming year. In order to allay any anxiety, it is necessary to point out that the plots concerned have received six times the quantity of superphosphate that would have been applied by a farmer in the same period.

The series of trials of fertiliser on yams, guineacorn and maize in Ilorin Province now show fairly conclusively that a significant and economic response can normally be expected from a dressing of 60 lbs. per acre of sulphate of ammonia applied to yams at the time of germination. Responses to higher dressings of nitrogen, and to dressings of phosphate, have been less consistent, and this is also the case with all fertilisers on guineacorn and maize in this area. It is not yet possible to make any definite recommendations for these last two crops.

Trials carried out on a wide scale in Benue and Plateau have not yet been fully analysed, but the indications are that cotton responds to nitrogen alone, groundnuts to phosphate and guineacorn to both.

Soil investigations included three reconnaissance surveys at Gadau, Bida and Kudarn and one semi-detailed survey at the new experimental farm in Lowlands division of Plateau Province. A semi-detailed survey of Samaru farm was started and will be completed in the coming year.

Routine analyses of samples of various kinds (fertilisers, silage, cattle dips, soil, feeding stuffs and fodders) kept the laboratories fully occupied, the largest item being over 400 samples analysed for the Pasture Section

Cotton Section: (a) Breeding.—Further results from replicated trials have confirmed that the new nucleus stock of Samaru 26C strain is a clear advance. It appears likely to give at least 6 per cent more lint per acre than the present stock 26C in commercial growth. This new seed was this season in the 3,000 acre stage of the Daudawa Seed Multiplication Scheme; sufficient for the whole of the cotton growing areas (some 13,000 tons) should be available in 1956-57.

More recent reselections from 26C under trial, and in the earliest stages of seed multiplication, continue to promise further advances. One in particular combines good yield with marked earliness of cropping and superior spinning quality. A large number of other selections under trial includes some of rather different growth characteristics. These are to be tested in areas where the yields are at present very low.

(b) Entomology.—Studies of insect pests have been continued. Evidence has been obtained that the damage caused to foliage and flower buds by Mirids can be compensated for by continued growth and fruiting of the plant.

In general this season in the main cotton areas damage by insects has not been the limiting factor in determining yield. Much loss of fruit occurs unrelated to the incidence of insects. As a result, the increases obtained this season by spraying with insecticides were disappointing.

Pasture Section.—The work of this section has continued to be mainly of an observational nature while supplies of seed are being built up and equipment accumulated.

Newly introduced grasses and legumes were planted out, and some of the latter showed considerable promise. Of earlier introductions, "Stylo" (*Styloxanthes gracilis*) continued to give promise as a satisfactory substitute for lucerne, and valuable information on the proper management of this crop was obtained.

Selection was started among the Rhodes Grasses (*Chloris gayana*) and three distinct types, each with its own potential value, were isolated.

Trials of methods of establishment and frequency of cutting of grasses were initiated at Samaru, while a series of management observations on existing paddocks at Shika gave valuable preliminary indications.

Detailed results of the experimental work mentioned in the foregoing paragraphs are to be found in the Annual Report of the Northern Research Station.

NORTHERN RESEARCH STATION, SAMARU

GENERAL INTRODUCTION

By J. H. Gisborne

Staff prospects have improved considerably during the year, and it has been possible to initiate more detailed investigations in a number of directions.

It has, however, been evident for some time that the present establishment was quite inadequate for the investigation of the mass of problems facing us. Early in 1953, estimates were put up for a Groundnut Research Scheme, to be financed by the Groundnut Marketing Board, and later in the year a similar scheme was prepared to cover Cotton research, for the consideration of the Cotton Marketing Board. It was clear, however, that separate commodity research schemes would represent a waste of resources through overlapping, and moreover that the wide field of food crop problems would not be touched by these two schemes. As the welfare of the main export cash crops is closely bound up with an overall improvement of the whole agricultural system, it was decided that a comprehensive scheme to cover the whole of agricultural research for the Region should be placed before the Government and the two Boards. A ten year plan, involving the expenditure of about £3,250,000, was accordingly prepared and has been approved in principle by the Government and the Boards. It is expected that this plan will shortly come into operation.

The ten year expenditure proposed, which is to be shared between the Regional Government and the two Boards in the proportion 20 per cent: 40 per cent: 40 per cent is divided into the following three headings:

Personal emoluments (including pension liability, etc.,	£ 1,535,361
Other charges, recurrent	1,034,130
Special expenditure (buildings and capital equipment,	675,000
	£ 3,244,491

A total establishment of forty-seven research officers and fifteen assistants will bring the total Senior Service staff up to sixty-two, with corresponding increases in the Junior Service staff. This compares with the present staff of fourteen.

Not all this additional expenditure and staff will be at Samaru: in particular Kano station is to be developed in connection with groundnut breeding, and a considerable intensification of work in the riverain provinces is envisaged, but Samaru will remain the main centre of the organisation.

STAFF

Lists of established staff in all sections appear as Appendix I of this report.

There was a considerable improvement in the senior staff position in the Botany section. A second Botanist arrived in August, who took over the work on grain crops and also started investigations in Pathology; and a third, posted in December took over the groundnut work. A Laboratory Superintendent was also appointed, and

while he has carried out work in connection with all sections at various times, his main duties have been in the Botany section. This section has therefore been stronger than ever before.

In the retirement of Mr W. E. Freeman, Senior Botanist, we have lost a man who was responsible for much of the development of the Botany section, of Samaru itself in recent years, and in particular of a detailed system of recording which has proved invaluable in the establishment of the Agronomy section. He was closely connected with the production of Samaru 38, Kano 38 and Kano 50 groundnuts and some of the more promising derivatives of Samaru 26C cotton.

The junior staff was strengthened by the posting of twenty-four assistants in July, bringing the total to seven Assistant Agricultural Officers and thirty-nine Senior Agricultural Assistants and Agricultural Assistants, but the numbers had decreased by the end of March to seven Assistant Agricultural Officers and thirty-five Senior Agricultural Assistants and Agricultural Assistants, owing to scholarships, transfer and normal wastage.

VISITORS

The following were among the many visitors to Samaru during the year:

Mr P. S. Achimugu, Minister for Agriculture and Natural Resources, Northern Region.

Mr A. M. Akinloye, Minister for Agriculture and Natural Resources, Western Region.

Mr and Mrs R. Stuart Cloete, South Africa.

M. J. P. Bachoux, M'Baiki, Oubangi-Shari.

M. R. L. Caillol, Loudima, Moyen Congo.

Raja J. Rameshwar Rao, Indian Commissioner for West Africa, Accra.

Mr D. R. Wilson, Deputy Government Statistician, Lagos.

Chief R. F. Omotade	} Members of the Western Cotton Representative Committee of the Cotton Marketing Board.
Chief S. U. Elabor	
Mr J. O. Akinade	
Prof. N. D. Oyemide	

MISSIONS

The following Members of the International Bank Mission visited Samaru on 29th-30th October:

Dr H. C. Trumble.

Mr T. Masar.

Mr N. R. Reid.

Mr J. R. de Fargas.

They saw the work of the various sections in detail, paid a visit to Shika, and were given access to all available information. In addition, Dr F. D. Patterson paid a brief visit to Samaru on the morning of the 30th.

METEOROLOGICAL DATA

TABLE I.—Meteorological data recorded at Samaru in 1953

<i>Month</i>	<i>Rainfall</i> 1953 <i>ins. (days)</i>	<i>Average</i> 1924-52 <i>ins.</i>	1953 <i>Mean</i> <i>RH%</i>	1953 <i>Mean</i> <i>Max. °F</i>	1953 <i>Mean</i> <i>Min. °F</i>	1953 <i>Mean</i> <i>Temp. °F</i>
January	—	0.001	27.4	90.6	57.6	74.1
February	0.33 (2)	0.04	35.8	94.8	61.8	78.3
March	—	0.31	44.0	97.3	68.0	82.7
April	—	1.22	26.3	97.4	69.6	83.5
May	10.07 (16)	4.94	63.4	89.4	71.0	84.7
June	5.97 (13)	6.42	70.8	86.9	68.8	77.9
July	11.56 (13)	8.83	74.8	82.6	68.2	75.4
August	8.74 (17)	11.45	76.1	82.0	68.3	75.2
September	8.92 (18)	8.64	70.4	85.3	67.2	76.3
October	0.30 (4)	1.44	52.5	89.8	64.9	77.4
November	—	0.03	22.9	89.4	58.5	73.9
December	—	0.005	21.0	84.7	54.7	69.7
Total	45.89 (83)	43.33				

The rains were very atypical: two showers in late February, traces of rain only twice in March a completely dry April, and a May rainfall far in excess of any previous record. Towards the end of June there was a dry spell which almost reached drought proportions, and July for the second year in succession proved the wettest month of the year. Early August was fairly dry, but heavy rains later in the month produced the usual waterlogging and drainage problems. The last rain was on the 20th October, and was followed by early onset of harmattan conditions.

BUILDINGS

An extension to the Botany section was completed, which provides additional accommodation for Junior Service staff, and also includes a dark room designed for use in physiological studies.

Three Senior Service quarters (one A53, one A62 and one T23) were started during the year, and the two former were completed.

Nineteen Junior Service quarters were started, and eight had been completed by 31st March. These eight are in the old Junior Service Housing Reservation, while the remaining eleven are the beginning of the development of a new residential area at the south eastern end of the station.

PART II.—AGRONOMY SECTION

By E. J. Butler

A.—GENERAL

CROPS

The establishment and growth of crops were to some extent adversely affected by the uneven rainfall. In particular, much of the guineacorn was hit by the dry spell in late June shortly after planting and this, coupled with fairly heavy damage by larvae of

cockchafer beetles necessitated much supplying and transplanting. Some of the cotton was planted later than normal, owing to the need to deal with an unusually heavy weed growth (brought on by the heavy May rains) before the planting could proceed. Groundnuts were to some extent affected by Rosette disease (again probably aggravated by heavy May rainfall) but by no means so badly as in the areas further south. The general pest and disease position is reviewed in the Botany Section's report (p. 40).

By far the most serious factor adversely affecting the crops was the chronic shortage of labour during the important months of May, June, and July. This was worse than ever, and made it almost impossible to keep up with the planting and weeding programme. Considering the conditions, yields of all crops were better than might have been expected.

A most pressing problem with which little progress has been made is the incidence of dhuh-grass (*Cynodon dactylon*) throughout the farm; this weed has become progressively more troublesome as the supply of labour for its early eradication has become shorter, and drastic measures to rid the station of it are now urgently called for.

Average yields over the farm were lower than in the previous year for all the main crops except cotton. These average yields are set out in Table 2.

TABLE 2.—AVERAGE YIELDS (LB. PER ACRE) OF MAIN CROPS, 1952-3 AND 1953-4

Season	Seed Cotton (Samaru 26C)	Guineacorn Grain (Light Mori)	Grain (Short Kaura)	Groundnut in shell (Samaru 38)
1952-3	301	1013	1173	1093
1953-4	430	603	1144	754

CATTLE

The policy of grading N'dama x White Fulani Zebu cross-breds both towards the pure N'dama and towards the pure Zebu type received a very serious set back through an outbreak of Rinderpest which occurred in June. In one month, the following losses were suffered:

Class	On hand 1/6/53	Died 21/6/53 to 21/7/53
Bulls	4	2
Cows	34	11
Young stock 1-3 years	38	29
Calves under 1 year	45	39

The most serious aspect was the almost complete wiping out of the $\frac{3}{4}$ breds which predominated in the last two of these classes.

The outbreak is attributed to a breakdown in the routine arrangements for inoculation. The balance of stock of various classes at 31st March, 1954 was as shown in Table 3.

TABLE 3.—NUMBERS OF ANIMALS IN ZEBU-NDAMA HERD AT 31/3/54

<i>Class</i>		<i>NZ x N</i>	<i>NZ x N</i>	<i>NZ</i>	<i>Z</i>	<i>N</i>	<i>Total</i>
Stock bulls ...	...	—	—	—	2	1	3
Cows ...	...	—	—	10	16	—	26
1-3 years Bulls ...	...	—	—	2	1	—	3
1-3 years, Heifers ...	...	—	—	5	—	—	5
Bull calves ...	...	1	4	6	—	—	11
Heifer calves ...	...	3	2	2	—	—	7
Total ...		4	6	25	19	1	55
Total 31/3/53		14	9	85	16	4	128

N=N'dama, Z=Zebu, NZ= $\frac{1}{2}$ bred.

B.—EXPERIMENTS REPORT

Throughout this section, significant differences are indicated by

* Significant at $P=.05$
 ** " " $P=.01$
 *** " " $P=.001$

GROUNDNUTS

(1) *Method of planting Groundnuts.*—An observation was carried out at Samaru on methods of planting groundnuts. The object was to see whether in the case of large scale farming the laborious hand-shelling of seed could be avoided. There were six treatments as follows:

K. Kernels sown as in normal practice.

S12. Seed in shell soaked 12 hours before planting.

S24. Seed in shell soaked 24 hours before planting.

S48. Seed in shell soaked 48 hours before planting.

SDC. Seed in shell sown dry but cracked between finger and thumb before planting.

SD. Seed in shell sown dry.

Data from the trial are presented in Table 4.

TABLE 4.—METHODS OF PLANTING GROUNDNUTS

	<i>K</i>	<i>S12</i>	<i>S24</i>	<i>SDC</i>	<i>SD</i>	<i>S48</i>
Yield kernels lbs/acre ...	1456	1252	1236	1164	1107	1010
Yield as per cent of best treatment	100	86.0	84.9	79.9	76.0	69.3
Threshing percentages ...	72.7	71.8	71.9	68.5	71.1	69.9
Dry hay lbs/acre ...	2002	1716	1826	1892	1606	1694
Percentage stand counts ...	95.0	88.0	88.8	90.5	86.3	85.6

Daily germination counts showed that shelled kernels got away to a quick start and maintained their superiority in growth throughout the season. Seed soaked for 12 and 24 hours in shell germinated more quickly than dry seed in shell but soaking for 48 hours adversely affected germination. It is evident that if seed is sown in shell a reduction in yield may be expected but this reduction will be less if the seed is soaked for up to 24 hours before planting.

(2). *Behaviour of Groundnut Variety Kano 50 in different localities.*—Trials were carried out for the fourth year at six localities in Kano Province to test the suggestion that the variety Kano 50 might lose its superiority over Local Spreading in the north of the province and whether in this zone ridged cultivation is better than flat. The 1953 data are presented in Table 5. Yields were in general very poor.

TABLE 5.—YIELDS OF GROUNDNUTS (LB. KERNELS PER ACRE) IN VARIETY AND CULTIVATION TRIAL

	<i>Kano N.A. Farm</i>	<i>Taura</i>	<i>Dambatta</i>	<i>Kazaure</i>	<i>Mallam Maduri</i>	<i>Birnin Kudu</i>
<i>Varieties</i>	<i>Not sig.</i>	<i>Not sig.</i>	<i>Not sig.</i>	<i>Not sig.</i>	<i>Not sig.</i>	<i>Not sig.</i>
Kano 50 ...	355	212	195	586	671	530
Local ...	323	144	222	564	626	557
<i>Cultivations</i>	<i>**</i>	<i>Not sig.</i>	<i>Not sig.</i>	<i>Not sig.</i>	<i>Not sig.</i>	<i>***</i>
Ridge ...	378	163	200	504	644	634
Flat ...	300	193	218	646	654	453
S.E. $\pm$...	10	34	26	44	50	22

Variety x Cultivation. Combined yields 1953

	K. 50	Local	Mean
Ridge ...	423	417	420
Flat ...	389	432	411
Mean ...	406	425	

Varieties.—Both in this year and the preceding years there is little to choose between the two varieties as appears in the following table of combined yields in lbs. kernels per acre.

	1953	1952	1951	1950
	<i>Not sig.</i>	<i>Not sig.</i>	*	<i>Not sig.</i>
Kano 50 ...	406	504	699	643
Local ...	425	474	747	609
S.E. $\pm$...		18	16	17

The doubt about the *bona fides* of Kano 50, expressed in last year's report, is intensified by these results, and by the results of the variety trial KR4 (53) at Kano, reported by the Botany Section (p. 42). It is therefore proposed in 1954 to reintroduce Kano 38 into variety trials, and find how it compares with Kano 50. In previous trials, the two varieties performed very similarly, but results were slightly in favour of Kano 50, which was therefore adopted for multiplication.

Cultivation.—In previous years planting on the ridge was better than on the flat averaging 647 as against 578 lbs. per acre. This year the difference was negligible with ridge averaging 421 as against 411 on the flat.

Interactions.—In 1953 none of the interactions was significant.

GUINEACORN

Effect of Striga on Yield.—Investigations into the effect of the parasite, *Striga senegalensis*, on the yield of guineacorn at different levels of fertility continued at Samaru and Yandev. Seed of the parasite was sown with the corn at Samaru but as it is known that very little germinates the first year the expected result was obtained that infection was not yet severe enough for the trial to be of use. There was an average of only 1 parasite per 3 stands of corn. At Yandev, relying on natural infection, there was a satisfactory average population of parasite of 52,000 to the acre. Results at Yandev were as follows:

<i>Fertility</i>	***		
10 tons F.Y.M./acre	302 lbs. grain per acre		
3 tons F.Y.M./acre	174		
Nil	77		
S.E. $\pm$	30		
<i>Eradication of Striga</i>	***		
Eradicated	293		
Not eradicated	76		
S.E. $\pm$	17		
Interaction	**		
	<i>Eradicated</i>	<i>Not eradicated</i>	
10 tons F.Y.M. ...	460	144	
3 tons F.Y.M. ...	293	54	
Nil ...	125	28	

Fertility.—There was the usual response to manure but yields were so poor even with 10 tons F.Y.M. that it is reasonable to presume that the parasite depressed yield. This is supported by the poor stand count at harvest of 4,562 per acre as compared with 8,631 at germination.

Eradication.—The highly significant response to hand weeding of the parasite is of interest as it contradicts a suggestion from the Sudan that hand pulling might reduce yield by stimulating the parasite to produce more aerial stems.

Interaction.—The significant interaction is due to the greater ability of manure to increase yields in the eradicated plots.

SUNFLOWER

A Spacing cum Manurial trial of Sunflower for silage was carried out at Daudawa for the second year. Spacings were 12, 18 and 24 inches on 3 feet ridges. Manuring was 0, 3 and 6 tons F.Y.M. per acre. Yields were as follows in lbs. per acre.

						<i>Green Weight</i>	<i>Dry Weight</i>
						***	**
Manuring	...	...	...	...	...		
Nil	...	...	...	...	...	11,184	1,396
3 tons	...	...	...	...	...	13,370	1,646
6 tons	...	...	...	...	...	15,026	1,854
Spacing	...	...	...	...	...	Not Sig.	*
6 inches	...	...	...	...	...	14,109	1,731
12 inches	...	...	...	...	...	13,361	1,715
18 inches	...	...	...	...	...	12,110	1,450
S.E. $\pm$	...	...	...	...	...	591	79
Interaction	...	...	...	...	...	Not sig.	

These results are in agreement with those of the previous year and of other stations. Farm Yard Manure significantly increases yield. Closer spacing increases yield but usually not significantly so. It also gives a product much more suitable for ensiling.

ROTATION

(1) *Effects of Monocropping.*—The comparison of crops grown continuously on the same land and grown in a rotation, at different levels of fertility, was continued at Samarú and Bida for the fourth year. At the former the rotation is Cotton, Guinea-corn, Groundnuts; at Bida it is Guinea-corn, Groundnuts, Cassava. The fertility levels are obtained by applying 0, 1, 3 and 5 tons F.Y.M. annually.

Guineacorn.—The marked adverse effect of monocropping on guineacorn was again obvious at both stations (see Table 6).

TABLE 6.—YIELDS OF GUINEACORN GRAIN (LBS. PER ACRE)

Samaru			Bida	
<i>Manuring</i>	<i>Monocropping</i>	<i>Rotation</i>	<i>Monocropping</i>	<i>Rotation</i>
Nil	550	727	55	106
1 ton/acre ...	737	1,164	81	670
3 tons/acre ...	1,190	1,424	474	801
5 tons/acre ...	1,107	1,176	713	1,298
Mean... ..	896	1,123	331	719

Groundnuts.—There is little difference in the yields of groundnuts under the two systems (Table 7). In fact at Bida monocropping did better: yields there however were very low and showed little response to manure and cannot be taken very seriously.

TABLE 7.—YIELDS OF GROUNDNUTS (LBS. KERNELS PER ACRE)

Samaru			Bida	
<i>Manuring</i>	<i>Monocropping</i>	<i>Rotation</i>	<i>Monocropping</i>	<i>Rotation</i>
Nil	524	626	121	148
1 ton/acre ...	920	986	193	104
3 ton/acre ...	1,524	1,792	118	146
5 ton/acre ...	1,777	1,695	289	128
Mean... ..	1,186	1,275	180	132

Cotton (Samaru).—The yields of cotton showed the same interesting interaction as before. Rotation is better than monocropping at the lower fertility levels but this is reversed at the highest rate. It seems that land in too high a state of fertility is not in an optimum state for seed cotton production and that this is balanced by the otherwise adverse effect of monocropping. Yields are in lbs. seed cotton per acre.

						<i>Monocropping</i>	<i>Rotation</i>
Nil	...	...	...	...	...	244	317
1 ton	...	...	...	...	...	311	486
3 tons	...	...	...	...	...	505	547
5 tons	...	...	...	...	...	772	517
Mean	...	...	...	...	...	458	467

CASSAVA (BIDA)

In previous years cassava in a rotation gave an average increase over monocropping of 861 lbs. per acre. In 1953 yields were variable and there was little difference between the two. Yields are in lbs. fresh tubers per acre.

	<i>Monocropping</i>					<i>Rotation</i>
Nil	...	...	...	...	596	983
1ton	...	...	...	...	3,066	2,713
3 tons	...	...	...	...	4,395	5,905
5 tons	...	...	...	...	6,619	5,838
Mean	...	...	...	...	3,719	3,860

(2) *Optimum Use of F.Y.M. in a Rotation.*—This experiment, designed to find out whether at different rates of manuring it is better to apply all the manure to the grain crop or to give part to the cash crops, was continued for the fourth year. The rotation is cotton, guineacorn, groundnuts and the manurial rates are 3 and 6 tons F.Y.M. over the 3 years of the rotation. Methods of application are (a) all to guineacorn (b) $\frac{1}{2}$ to guineacorn $\frac{1}{2}$ to cotton (c) $\frac{1}{3}$ to each crop. Yields in lbs. per acre are as follows:

					<i>Seed Cotton</i>	<i>Guineacorn</i>	<i>Groundnuts</i>
Rates of Manure					**	*	***
3 tons	...	...	...	...	451	886	890
6 tons	...	...	...	...	573	1,032	1,123
S.E. $\pm$	...	...	...	...	22	41	29
Method of Application					**	Not sig.	***
All to corn... ..	...	...	...	...	404	1,018	961
$\frac{1}{2}$ corn $\frac{1}{2}$ cotton	...	...	...	...	587	990	888
$\frac{1}{3}$ to each	...	...	...	...	547	869	1,171
S.E. $\pm$	...	...	...	...	27	51	36

The interaction was not significant and is presented in the form of a table (Table 8) showing increases (+) and decreases (—) resulting from the modifications of the standard practice of applying all the available manure to guineacorn.

TABLE 8.—YIELDS AND INCREASES (LB/ACRE) RESULTING FROM SPLITTING THE APPLICATION OF F.Y.M.

		<i>3 tons F.Y.M.</i>			<i>6 tons F.Y.M.</i>			<i>Average</i>		
		<i>C</i>	<i>G</i>	<i>P</i>	<i>C</i>	<i>G</i>	<i>P</i>	<i>C</i>	<i>G</i>	<i>P</i>
All to G....	...	384	867	841	424	1,168	1,080	404	1,018	961
$\frac{1}{2}$ G. $\frac{1}{2}$ C.	...	+135	+47	—33	+230	—103	—112	+183	—28	—73
$\frac{1}{3}$ each ...	...	+67	+9	+179	+218	—306	+242	+143	—148	+211

C=Cotton. G=Guineacorn. P=Groundnuts.

It is interesting that guineacorn, which normally receives all the manure is the only crop which is not significantly affected by the modifications. This was also the case in the previous 3 years.

It appears that the standard practice of applying all the manure to guineacorn is economically unsound. Assuming prices per pound of 3d for corn, 6d for cotton and 4d for groundnuts the modifications result in the following grains per acre:

$\frac{1}{2}$ G. $\frac{1}{2}$ C.	£3- 8- 3 at 3 tons F.Y.M. level.
	£2-11-11 at 6 tons F.Y.M. level.
$\frac{1}{3}$ to each	£4-15- 5 at 3 tons F.Y.M. level.
	£5-13- 2 at 6 tons F.Y.M. level.

It appears also that at both levels of fertility applying $\frac{1}{3}$ of the manure to each crop gives the best return.

(3) *Extension of Cropping in a Rotation with Fallow*.—At Yandev the standard rotation is a 3 year fallow of *Andropogon gayanus* followed by a 3 years cropping of Yams, Grain, Bennisseed. (The grain consists of Guineacorn interplanted with Bulrush Millet). It was desired to see if the rotation could be extended by applying artificial fertiliser either to a second crop of yams or to the first crop of grain hoping that a second crop of grain would profit sufficiently from the residual values to be successful. The yields for the first three years are as follows in lbs. per acre.

1951 Yams Straight crop. Average yield 4,956 lbs. acre

1952	Yams + Fertiliser	Yams	Grain + Fertiliser	Grain
	8,395	6,766	1,332	666
1953	Grain	Grain	Grain	Grain
	672	338	343	180

As might be expected both rotations with fertiliser are clearly superior to those without. The yield of grain after the second crop of yams + fertiliser is satisfactory and this method of extending the rotation seems a practical proposition. The result is of value as there is a shortage of land in that area. The fertiliser mixture used consisted of 150 lbs. each of Sulphate of Ammonia and Superphosphate.

FALLOWS

Many of the following experiments in this region are of recent origin and have not yet reached the stage at which conclusions may be drawn. This applies to 9 such experiments at Bauchi, Daura, Bida, Riyom, Samaru, Yola, and Yandev.

(1) *Yandev. Pigeon Pea v. Andropogon gayanus Fallows*.—The rotation is 4½ years fallow followed by Yam, Grain (Guineacorn interplanted through Millet), Bennisseed. In the first cropping cycle there were no significant differences between the treatments. Yields to date in the second cycle are as follows in lbs./acre.

		1952 Yams	1953 Grain
After Pigeon Pea		13,013	513
After Andropogon		13,218	531
Difference...		205	18
S.E. ±		365	48
		Not Sig.	Not Sig.

There seems to be no difference in the effectiveness of the two types of fallow, but both have satisfactorily maintained fertility.

(2) *Yandev. Continuous Cropping with F.Y.M. v. Fallows*.—The object is to compare different types of fallows, of methods of treating them and to see how F.Y.M., 3 ton per acre, applied to the yam crop only compares in maintaining fertility. The fallows are of 3 years duration followed by 3 years of cropping. In 1953 the second crop of the 3rd cropping cycle was taken—Guineacorn interplanted with Millet (See Table 9).

TABLE 9.—F.Y.M. vs. FALLOWs, YANDEV. 1953 YIELDS (LBS. GRAIN PER ACRE)

Continuous cropping with F.Y.M.	...	...	...	...	959
Andropogon cut and let rot in situ	...	...	...	...	883
Natural Regeneration	...	...	...	...	851
Andropogon cut in the third year, composted and returned	...	...	...	...	813
Andropogon fallow untreated	...	...	...	...	798
Pigeon pea fallow	...	...	...	...	691
S.E.	...	...	...	...	±58
					Not Sig.

Yields were not significantly different either in 1953 or in 1952. In the previous cropping cycle the only significant difference was when the grain yield after natural regeneration was better than all others ($P = .05$). All treatments are maintaining fertility satisfactorily.

(3) *Maigana. Fallow Treatment.*—This trial was designed to find the effect of different methods of treating three years fallows of natural regeneration and Elephant grass. Cotton, the first test crop, was taken but the yields (shown below) were so low as not to be worth statistical analysis:

<i>Fallow and Treatment</i>					<i>lb. seed cotton per acre</i>	<i>Mean</i>
Elephant grass left untouched	...	...	...	...	218	206
Bush fallow left untouched	...	...	...	...	195	
Elephant grass early burnt annually	...	...	...	...	41	72
Bush fallow early burnt annually	...	...	...	...	104	
Elephant grass late burnt annually	...	...	...	...	125	108
Bush fallow late burnt annually	...	...	...	...	92	
Elephant grass cut and carried annually	...	...	...	...	105	140
Bush fallow cut and carried annually	...	...	...	...	176	
Groundnuts planted annually	...	...	...	...	38	38

The untouched fallows gave the highest yields, but plot to plot variation was so high that little reliance can be placed on the results.

(4) *Bauchi. Type of Fallow.*—Three year fallows of *Mucuna*, *Andropogon gayanus* and *Pennisetum pedicellatum* were compared with the normal three course rotation of Cotton, Guineacorn, Groundnuts receiving three tons F.Y.M. to corn. The first test crop was cotton which yielded as follows in lbs seed cotton per acre.

Pennisetum	...	...	...	...	...	235
Mucuna	...	...	...	...	...	219
Andropogon	...	...	...	...	...	210
Rotation	...	...	...	...	...	191
S.E. ±	...	...	...	...	...	10

Not sig. (approaches significance at $p = .05$).

Yields were disappointing. It was noted that *Mucuna* was almost completely replaced by natural invasion of *Pennisetum* and *Andropogon*. The only possibility of carrying out this treatment would be annual replanting of *Mucuna*. *Pennisetum* gave a good cover the first year and persisted well. The cover of *Andropogon* was thin the first year but subsequently excellent. Possibly a mixture of the two would be best,

ORGANIC MANURES

(1) *Rates of F.Y.M. in Continuous Cropping.*—At Yandev an experiment was conducted from 1940 to 1951 to find the optimum rate of application of F.Y.M. to the grain crop in a rotation of Yams, Grain, Benniseed. The manurial rates were 1, 2 and 3 tons F.Y.M. per acre. It was found that 1 ton was declining in fertility, 2 tons was holding its own and 3 tons was gradually improving. It was then decided that more information could be obtained on maintenance of fertility by changing the treatments as follows:—

Control	...	...	...	...	...	...	Increase 1 ton to 1½ tons
A.	...	...	...	...	...	...	Increase 2 tons to 3 tons
B.	...	...	...	...	...	...	Decrease 3 tons to nil.

Yields for the first two years of the altered treatments were as follows in lbs seed per acre.

						<i>Benniseed, 1953</i>	<i>Grain, 1952</i>
Control	...	...	...	...	...	100	728
A	...	...	...	...	...	112	938
B	...	...	...	...	...	108	870

one of the differences was significant but it was not expected that the treatments would have much effect in the first cropping cycle.

(2) *Night Soil Compost.*—A considerable tonnage of night soil compost had accumulated at Samaru and its value compared with F.Y.M. was tested. The crop was Guinea corn and results were as follows:

3 tons F.Y.M. per acre	1,642 lbs grain per acre.
6 tons night soil/acre	1,605 lbs grain per acre.
3 tons night soil/acre	1,533 lbs grain per acre.
Nil	941
S.E. ±	105

F.Y.M. and 6 tons compost were significantly better than nil ($P=0.001$) and 3 tons compost was better than nil ($p=0.01$). There were no other significant differences. The night soil compost seems little, if at all, inferior to F.Y.M.

(3) *Groundnut Cake as a Fertiliser.*—At the request of the Groundnut Marketing Board a last minute trial was undertaken at Samaru to test the value of groundnut cake as a fertiliser. The test crop was Groundnuts and, being late planted, suffered so badly from rosette as to make the results useless. It was noted however that the cake had a bad effect on germination as appears from the following stand counts.

						<i>Percentage</i>
Nil	...	...	...	...	...	94.8
60 lbs superphosphate per care	...	...	...	...	...	94.5
2 tons F.Y.M. per acre	...	...	...	...	...	92.5
929 lbs cake per acre	...	...	...	...	...	69.0
2,420 lbs cake per acre	...	...	...	...	...	54.7

The two rates of groundnut cake were chosen to have the same content of nitrogen and phosphorus respectively as 2 tons F.Y.M.

(4) *Urea as a Fertiliser.*—A small scale trial was laid down at Samaru to test the efficiency of Urea as a nitrogenous fertiliser. Sulphate of Ammonia was applied to cotton at 56 and 112 lbs per acre and Urea at rates of equivalent nitrogen content.

Urea	...	...	...	51 lbs per acre	665 lbs seed cotton/ac.
Sulphate of Ammonia	...	...	...	112 lbs per acre	649 lbs seed cotton/ac.
Sulphate of Ammonia	...	...	...	56 lbs per acre	616 lbs seed cotton/ac.
Urea	...	...	...	25½ lbs per acre	558 lbs seed cotton/ac.
Nil	...	...	...	546 lbs seed cotton/ac.	
S.E.	...	...	...	±54	Not sig.

The yield of the nil treatment was high for the area and the site obviously not greatly in need of nitrogen.

(5) *Permanent Manurial Demonstration, Kano.*—Millet and groundnuts have been cropped since 1931 on the same land manured annually with 3 tons F.Y.M. versus nil. Yields in 1953 were as follows in lbs. threshed seed per acre.

						<i>Millet</i>	<i>Groundnuts</i>
3 tons F.Y.M. annually	...	...	...	...	...	752	776
Nil	...	...	...	...	...	207	478
S.E. ±	...	...	...	...	...	96	29
						sig.	sig.

A yield of 478 lbs of groundnuts after twenty-three years of monocropping without manure is remarkable.

(6) *Restoration of Fertility, Kano.*—The same trial as in the previous paragraph, but on guineacorn, was stopped after 1949 as the yield of corn on the unmanured plots had fallen almost to nil. The trial was converted into two Latin Squares. In one various treatments were applied to the previously unmanured plots to study how best fertility could be restored. In the other various rates of F.Y.M. were applied to the previously manured plots to see how they maintained fertility. Cropping with guineacorn continued (Tables 10 and 11).

TABLE 10.—PREVIOUSLY UNMANURED (LB GRAIN PER ACRE)

<i>Annual dressing</i>	1953	1952	1951	1950
3 tons F.Y.M. per acre	372	491	616	247
75 lbs N, 150 lbs P per acre	175	205	450	33
75 lbs N per acre	106	155	266	7
150 lbs P per acre	91	207	389	36
50 lbs K per acre	81	173	321	8
Nil	66	133	272	4
S.E. ±	31	14	34	14

N=Sulphate of Ammonia

P=Superphosphate

K=Muriate of Potash.

It is clear that on the previously unmanured plots fertility is gradually being restored by the F.Y.M., and more slowly by the NP dressing. There are indications of a small increment also from Potash, which in normal cropping has, if anything, a slightly depressing effect at Kano. It is possible, therefore, that the normal fertility could be regained by full NPK applications as quickly as by F.Y.M. Leaf samples from each plot were sent to England for spectrographic analysis to see if any deficiency of a micronutrient element existed. When the results from these samples are received, a decision will be taken on the modification of the present treatments.

TABLE 11.—PREVIOUSLY MANURED (LB. GRAIN PER ACRE)

	*** 1953	** 1952	Not Sig. 1951	* 1950
3 tons F.Y.M. annually	893	1,053	974	816
2 tons F.Y.M. annually	818	863	986	665
3 tons every 3 years ...	776	979	1,032	828
1 ton annually ...	670	799	918	608
2 tons every 3 years ...	626	876	829	693
Nil ...	330	584	813	539
S.E. $\pm$...	67	52	77	66

On the previously manured plots, 3 and 2 tons annually and 3 tons every 3 years do not differ significantly and appear to be maintaining fertility. But it should be noted that this was the year in which the 3 tons every 3 years was applied. One ton annually is doing fairly well and is significantly inferior only to 3 tons annually. 2 tons every 3 years, although applied this year is slightly worse and is significantly inferior to 2 and 3 tons annually. In the nil treatment the residual effect of 19 years of manuring maintained fertility for two years but it is now going downhill and is significantly inferior to all other treatments.

PART III.—BOTANY SECTION

By A. R. MAURER, E. HARRISON AND C. W. MORGAN

A.—WORK AT SAMARU

PERMANENT ROTATION PLOTS (A.R.M.)

This project was initiated in 1948 and consists of a straight rotation of Cotton, Guineacorn and Groundnuts. An application of 3 tons of F.Y.M. is placed on the Guineacorn course.

The object is to record over many years the yields and general growth characters of the three crops and eventually to correlate these factors with climatic variation from year to year.

Table 12 compares yields, dates of planting, number of wet days, rainfall after 1st May and total rainfall for the six years since 1948.

TABLE 12 YIELD DATE ETC., FROM PERMANENT ROTATION PLOTS

	COTTON		GUINEACORN		GROUNDNUTS		No. of wet days after 1st May	Rainfall after 1st May Ins.	Total Rainfall for year Ins.
	Planting date	Yield lb/acre	Planting date	Yield lb/acre	Planting date	Yield lb/acre			
1948 ...	2-7-48	449	28-5-48	1,665	25-6-48	1,209	84	31.59	35.31
1949 ...	6-7-49	305	28-5-49	1,424	24-6-49	1,200	67	38.43	38.93
1950 ...	3-7-50	472	25-5-50	1,355	23-6-50	1,209	79	34.54	35.39
1951 ...	5-7-51	431	6-6-51	1,243	22-6-51	666	93	44.47	45.67
1952 ...	3-7-52	175	6-6-52	743	13-6-52	1,441	83	43.24	43.51
1953 ...	3-7-53	70	5-6-53	316	13-7-53	346*	79	45.56	46.25

Cotton is given in lbs. seed cotton per acre.

Guineacorn is given in lbs. dry threshed grain per acre.

Groundnuts are given in lbs. shelled nuts per acre except *1953 which is unshelled yield.

Results to date are not encouraging and it would seem that fertility is being gradually decreased. Another factor which may be entering into the steady deterioration of crop yields is water-logging. From visual observations it seems that these plots are retaining more water each year. This may be associated with a change in the soil structure after continuous cultivation. There may be an effect of packing caused by the use of mechanical equipment. Another factor may be that cultural operations are not done as well as they should be due to the critical labour shortages experienced in the past few years. Weeds, especially dhub grass are certainly more prevalent than they used to be.

It is proposed to continue this experiment in its present site and also to repeat it in a new area, possibly the North West Extension.

GROUNDNUTS—(ARACHIS HYPOGAEA) (C.W.M.)

(1) *Breeding work at Samaru: (a) Selection.*—The new selection programme mentioned in last year's report has gone ahead, but nothing definite can be stated at this stage.

(b) *Hybridisation.*—Many of the hybrid nuts set in 1952-53 failed to germinate when planted out; those that did however are now pegging.

Despite the lack of facilities it is intended to intensify this line of breeding work this year. In Daura for example the Local Spreading Variety has always proved superior to anything produced by selection. However by using the Local Spreading type as one parent on many of our high yielding Samaru varieties it is hoped to release a whole range of new recombinations which can then be selected out.

(2) *Classification.*—Work is well in hand with a classification of all the varieties of groundnuts maintained at Samaru with a view to being able to place in its respective group any sample of unnamed nuts sent in. The international system, as recommended by the Groundnut Mission, is being adopted. This takes into account not only size, weight and colour of nuts and kernels but also such characters as beak size and shape, type and depth of venation, thickness of testa, etc. etc.

(3) *Introductions.*—Main interest has centred on a variety Mwitunde being introduced from Tanganyika and said to show some degree of field resistance to Rosette disease. Rosette causes considerable losses in crop yield all over the North of Nigeria in some years but especially in the Middle Belt where complete failure often results from a widespread attack. The variety Mwitunde is said to be fairly mixed and there is hope that superior material may be selected out.

Twenty-one varieties of groundnuts were also introduced from Georgia Experimental Station, United States of America. These were mostly of the Virginia Runner and Bunch type.

(4) *Groundnut Variety Trial A1 (53).*—In this trial the seasonal variations of 15 varieties are tested under Samaru conditions. Table 13 shows this year's and previous years' results. Yields this year were higher than average with shelling percentages correspondingly better. MJ. 371 which up to last year had held a steady position near the top of the table slipped down to thirteenth place. Climatic conditions seemed to favour MK. 383 this year; it did well at Samaru and was also in top position of a similar trial at Kano.

TABLE 13 GROUNDNUT VARIETY TRIALS (1) SAMARU 1946-53

<i>Year</i>	1946	1947	1948	1949	1950	1951	1952	1953	1953 Yield Unshelled Nuts	1953 Yield Shelled Nuts	1946-53 Average in lbs per Acre Shelled Nuts
<i>No. of Varieties</i>	25	25	12	15	15	15	15	15			
Mache Atsugune	—	—	—	—	—	—	—	2	1,852	1,280	(1,280)
MK 383 ..	15	2	7	2	1	2	9	4	1,835	1,248	1,071
Samaru 38 ..	11	5	4	12	5	6	7	3	1,771	1,272	1,054
MK 374 ..	5	3	11	5	8	12	10	1	1,789	1,280	1,046
MJ 371 ..	2	10	6	3	2	5	1	13	1,806	1,163	1,030
Castle Cary ..	10	6	1	6	4	9	12	9	1,735	1,217	1,028
MJ 374 ..	1	7	2	4	3	13	2	10	1,826	1,215	1,028
Kano 50 ..	—	—	—	—	9	3	5	5	1,739	1,235	1,027
MG 371 ..	4	20	5	10	11	4	11	8	1,743	1,225	1,023
ML 3710 ..	12	19	3	13	13	11	13	7	1,701	1,226	1,015
ML 372 ..	2	15	12	11	15	1	14	6	1,750	1,226	1,014
ML 384 ..	16	4	10	9	10	14	3	11	1,651	1,181	986
ML 378 ..	8	17	7	8	6	8	6	14	1,592	1,149	982
Samaru 38 Ex-Kontagora	—	—	—	—	12	7	8	12	1,768	1,167	944
M'Putu A	—	—	—	—	—	—	—	15	1,270	858	(858)

Columns 2-9 show the relative positions (out of the total shown below the year) of the varieties in the year named.
Columns 10-12 give yields in lb. per acre.

Mache Atsugune included this year in place of Natal Common seems to have made a good start whereas M'Putu A included in place of Kano 38 was well below any of the others.

Varieties change positions in the table so radically each season that it is difficult to assess their actual value. The average figures over the whole period show that all the long tested varieties are good yielders, and there is little to choose between them, although each year one or two are significantly better than others in that particular year. Varieties which have been better than average more often than not are MK. 383, Samaru 38, MJ. 371, Castle Cary, MJ. 374 and Kano 50.

(5) *Groundnut Variety Trial II*.—In the experiment in 1953 seven of the "L" selections which had constantly yielded better than Samaru 38 in the reselection trial (see page 32 of last year's Annual Report) were included. Five of them gave significantly better yields than Castle Cary and will now go forward to the Main Variety trial next year.

Table 14 gives the adjusted yields per acre in lbs. in descending order.

TABLE 14.—YIELDS IN GROUNDNUT VARIETY TRIAL II

<i>Variety</i>	<i>Yield of kernels per acre in lbs</i>
L 235	1,463
L 234	1,432
L 245	1,377
L 250	1,367
L 60	1,318
Castle Cary	1,296
L 260	1,292
Mache Atsugune	1,291
Castle Cary ex Bida	1,288
L 258	1,253
Yipa	1,190
Tudun Wada	989
M'Putu A	731
Kono	426
Toro	379
Sig. diff. at 5 per cent	160

(6) *Groundnut Reselection Trial A7* (53).—The best 'L' selections which had gone forward to the second variety trial were replaced by six new reselected varieties, making fourteen in all to be compared with Samaru 38. Castle Cary was also added as a further standard.

Yields were only average, but several of the varieties newly introduced to the trial were superior to Samaru 38. Castle Cary did extremely badly. Table 15 shows the results.

TABLE 15.—YIELDS IN GROUNDNUT RESELECTION TRIAL

<i>Variety</i>	<i>Yield in lbs kernels per acre</i>
14T12	827
L 200	815
15A167	805
L 121	751
18B138	742
Samaru 38	739
L 126	696
17B62	677
10A166	655
23T42	644
L 53	627
L 260	589
L 272	579
L 366	561
Castle Cary	410

S.E. ± 46

(7) *Groundnut Early Varieties Trial A1* (53).—This trial (Table 16) was designed to test the relative yields of nine of our early maturing varieties and also compare the length of time needed by each from planting to maturity. This is the first year of the trial which will be repeated for several seasons. In view of the way varieties seem to fluctuate in performance from year to year, it will be a few years before any positive conclusions can be drawn.

TABLE 16.—GROUNDNUT EARLY VARIETIES TRIAL

<i>Variety</i>	<i>Yield in lbs per acre kernels</i>	<i>Days from planting to Maturity (approximate)</i>
279-6	1,134	111
278-4	970	111
Spanish 205	953	111
Dixie Runner ...	949	123
Natal Common ...	880	111
Valencia	784	111
Kono	778	111
Phillipine White ...	773	123
Toro	489	111

(8) *Groundnut Trial on the Effects of Fumigants*.—This trial, again the first of a series, was designed to test the relative effects of various fumigants and preservatives on germination of groundnuts.

The groundnuts were all shelled in February, enough seed for each treatment was then dressed with the chemical concerned and stored in a closed drum until planting time. Compounds in the form of a powder were merely dusted onto the nuts in the drums. The liquid preservatives were placed in Petri dishes at the top of the drum from where the fumes could percolate down to the nuts below.

Results were in fact, insignificant but all the treatments yielded better than the control.

In all, five separate varieties of groundnuts were used for this trial namely: Samaru 38, MK. 383, Nigerian Local Mixture, Phillipine White and Dixie Runner. No one variety seemed unduly effected by the fumigants and each gave a yield typical of its performance at Samaru.

Yields for the various treatments are shown in Table 17.

TABLE 17.—YIELDS AND GERMINATION, SEED FUMIGATION TRIAL

<i>Fumigants and Preservatives</i>	<i>Yields in lbs kernels per acre</i>	<i>per centage germination count</i>
Carbon Disulphide	959	80.9
Carbon Tetrachloride	954	83.9
Killoptera	935	84.9
Agrocide	918	84.5
Gammexane	905	84.8
Napthalene	867	82.2
Control	832	82.0

GRAIN CROPS (E.H.)

MILLET—(Pennisetum typhoideum)

(a) *Millet Early Maturing Yield Trial A5 (53)*.—Fifty-five selections of early maturing millet were compared in a yield trial. The best selection, No. 9, yielded 1,188 lbs/acre. The trial is to be repeated in 1954.

(b) Crosses of some of the best of these early maturing selections were made and a trial of fifteen F¹ hybrids will be laid down in 1954.

(c) It is believed that in some areas, particularly in Plateau Province, gero will not set seed because rain at flowering time prevents fertilisation. Millet varieties will be planted in farm garden observation plots in seven areas in 1954 in an attempt to find suitable gero varieties for these areas.

GUINEACORN—(SORGHUM VULGARE)

The abnormally low yields of guineacorn at Samaru in 1953 were apparently due to a combination of heavy stem borer attack and early cessation of the rains.

(a) *Dr. Webster's Programme*.—Dr. Webster's programme has been carried on. New crosses between Nigerian and American varieties have been made and selection of the hybrids has continued.

(b) *Variety Yield Trial AR15 (52) 53*.—This experiment was designed to compare the yields of the local guineacorn varieties Farafara, Light Mori, Short Kaura and Tall Kaura and has been carried out for the last three years. Yields (in lbs grain per acre) are presented in Table 18.

TABLE 18.—GUINEACORN VARIETY YIELD TRIAL (LB GRAIN PER ACRE)

<i>Variety</i>					<i>Yield 1951</i>	<i>Yield 1952</i>	<i>Yield 1953</i>
Tall Kaura	...	...	...	...	1,262(a)	1,997	181
Short Kaura	...	...	...	...	2,108	1,739	269
Light Mori	...	...	...	...	2,466	1,642	143
Farafara	...	...	...	...	2,141	1,625	127
S.E....	...	...	...	...	±106	±103	±59

Tall Kaura headed about two weeks earlier than the other varieties in 1951 and suffered very heavy bird damage as a consequence.

The results were significant in 1951 but insignificant in 1952 and 1953. It appears that the small differences between the varieties are mainly random. This trial will not be repeated in 1954.

(c) *Farafara (Mass Selection) Yield Trial AR 15 (52) 53*.—This trial was started in 1949 to compare ordinary mass selection of a guineacorn variety with various modifications of mass selection to determine a satisfactory method of improving a variety on a Provincial Farm. 1953 was the third year in which the eight different methods of mass selection were compared in a yield trial, yields for the three years are shown in Table 19.

The selection methods and the ideas behind them were outlined in last year's report. There were no significant differences in 1952 or 1953, but as in 1951, normal mass selection gave a somewhat higher yield than no selection.

The conclusion appears to be that, in a well established variety with little inherent variability, normal mass selection of a few good heads selected for size and type, is adequate to maintain the variety. In a less uniform variety, methods three to five are worth further trial, but there appears to be no need to persist with methods six to eight, which were intended to avoid the possibility of contamination in the early stages of selection and multiplication.

TABLE 19.—GUINEACORN MASS SELECTION YIELD TRIAL
YIELDS IN LB GRAIN PER ACRE

	1951	1952	1953
1. Control: unselected—a small plot planted and re-established annually from unselected seed	2,135	1,658	284
2. Normal mass selection. The annual selection of 100 good heads selected for size and type	2,495	1,651	377
3. Bulk open pollinated high yielding selections: heads selected as in 2, grown as replicated progeny rows for one year, the eight highest yielders then bulked and subsequently multiplied without further selection... ..	2,365	1,674	313
4. Bulk open pollinated medium selections: ditto, but eight medium yielders bulked. ...	2,058	1,530	258
5. Bulk open polinated worst selection: ditto, but eight worst yielders bulked	1,840	1,616	319
6. Bulk selfed seed from high yielding selections: same selections as method 3, except that original selections were made from selfed heads instead of open pollinated.	2,055	1,578	341
7. High yielding open pollinated progeny from selfed seed; as method 3, except that original selections were made from selfed heads instead of open pollinated.	2,133	1,649	428
8. Selfed seed from the eight highest yielding rows planted from selfed plants.	2,148	1,537	387
S.E.	±127	±109	±31

(d) *American Sorghum Variety Yield Trial AR 17 (52) 53*.—This experiment (see Table 20) was a repeat of that carried out in 1952 to compare the yields of thirteen American varieties of sorghum.

TABLE 20.—AMERICAN SORGHUM VARIETY TRIAL
YIELDS IN LB/ACRE GRAIN

<i>Variety</i>	1952	1953
Hegari	1,733	588
Ladore	1,533	826
Pink Kafir	1,077	282
Martin	930	349
Sedan Red	817	390
Dwarf Shallu 5770	737	145
Redland	705	100
Gurno	679	228
Dwarf Shallu 5651	626	207
Midland	624	228
Redbine	617	149
Dwarf Kafir	475	74
Combine 60	254	122
Short Kaura	(Not included)	15

The local variety Short Kaura, included in 1953 as a control, was useless for the purpose as it was left standing in individual plots in the field after the American varieties had been harvested. American varieties mature about three months before the local varieties and we have no comparable local variety to use as a control.

The varieties Hegari and Ladore which gave the highest yields in 1952 were again outstanding. The drawback of these varieties is that they ripen in the middle of the wet season, have to be dried under cover and tend to become mouldy and unpalatable.

MAIZE (ZEA MAYS)

Results from trials at Samaru and stations in the North are sent to the Botanist, Ibadan, whose responsibility it is to report them.

RICE (ORYZA SATIVA)

(a) *Maintenance*.—The collection of over 100 local and introduced varieties was planted in very small plots at the Samaru Dam Site. The varieties were rogued and selfed to keep them pure. Seed of the variety G79 was grown for the first stage of the G79 Multiplication Scheme at Maigana.

The collection of rice varieties will be taken over by the Rice Research Station in 1954 and the Samaru Dam Site will be used only for producing a nucleus stock of pure G79 for the Maigana Multiplication Scheme.

OTHER CROPS (A.R.M.)

SOYA BEAN (GLYCINE MAX.) AND SUNFLOWER (HELIANTHUS ANNUUS)

Due to the shortage of staff and labour at the beginning of the year, it was decided that work should be curtailed with these two crops at Samaru. All varieties were maintained, however, and in 1954 the experimental programme will be continued and, if necessary, expanded.

SUGAR CANE (*SACCHARUM OFFICINALE*)

Additional varieties of sugar cane have been received from abroad and these are being grown at Samaru and Maigana. Testing for resistance against Red Rot is getting under way but cannot get into full swing until the laboratory is electrified. This should be accomplished before the end of 1954.

Multiplication of any resistant new varieties of sugar cane is a problem which has been receiving attention. The following policy is being followed:

- (a) Canes are cut for propagation as soon as they are tall enough and thick enough.
- (b) The whole cane is used instead of only the tip.
- (c) Trials are being conducted to test the effect of hotwater treatment on canes for propagation. This treatment is said to stimulate all the buds on a cane whereas normally only the buds near the tip of the cane germinate readily.

By these means propagation is carried on throughout the year instead of seasonally.

Preliminary results on hot water treatment of canes indicate that the method is well worth while. In the first trial, 90 per cent of the buds on whole canes germinated. In the second trial where a control was used, the number of germinations of treated canes versus the number on untreated was 44 to 19. These results are encouraging and further work will be carried on.

An interesting observation on hot water treated canes at Maigana is that any canes contaminated with red rot show the infection very rapidly after treatment. The only difficulty encountered to date is that treated canes are much more susceptible to termite attack.

TOBACCO—(*NICOTIANA TABACUM*)

The Nigerian Tobacco Company has again given us assistance in conducting a tobacco variety trial. Varieties were supplied by the Company but once again we had bad luck with establishment of seed beds and damping-off disease drastically reduced the numbers of seedlings available for the trial.

The experiment was sited in bush plot 4 on an upland soil which did not suffer from water-logging to the same degree as the contoured extension strips. The fertility of this soil was only fair and yields were lower than expected. The final results are not yet ready as the tobacco is still curing.

In 1954 the experiment will be placed on newly cleared land and it is hoped that fertility will be adequate and that water-logging will be negligible.

CASSAVA—(*MANIHOT UTILISSIMA*, *M. PALMATA*)

(a) *Cassava Yield Trial (Mosaic Effect) A10 (52)*.—This experiment is part of a series of trials begun in 1949 to determine the effect of mosaic on yield. This year's results were again insignificant and the order of yield did not agree with previous results. The 1949-50 trial was a failure due to lack of planting material. Previous to 1949 a trial had been conducted using "clean" Dan Warri from Samaru vs. infected Dan Warri from Zonkwa (A2(48)). The results were significantly in favour of the clean Samaru Dan Warri but no conclusions could be drawn as the Zonkwa strain may not have been identical to that grown at Samaru. The 1949 trial was therefore designed to include Samaru Dan Warri multiplied from plants which became infected during 1948. For results see Table 21.

TABLE 21.—CASSAVA MOSAIC YIELD TRIAL. (LB. TUBERS PER ACRE)

	1948-49	1950-51	1951-52	1952-53
Infected Samaru Dan Warri	—	10,966	11,000	10,854
Infected Zonkwa Dan Warri	7,020	12,849	12,633	9,114
Clean Samaru Dan Warri	10,390	11,873	12,300	8,966
Sig. difference 1 per cent	2,101	N.S.	N.S.	N.S.

The trend reported last year in favour of clean Samaru Dan Warri has not been maintained and there seems to be little difference between yields of infected and clean Dan Warri. This would suggest that infection of Dan Warri variety with mosaic disease has not reduced yields unduly. Further trials are being conducted but 1953-54 results are not yet ready as harvesting takes place in June and July.

(b) *Cassava Clones Yield Trial—A11 (52)*—(Table 22)—This trial is a continuation of a series of experiments started in 1950 to test the yields of fifteen varieties. All of these varieties with the exception of CH28, CH50, Dan Warri and Two Cent are open-pollinated seedlings, first grown at Samaru in 1946. Code letters of the female parents of these clones are as follows:

A—Maiduguri Dan Warri

B—Ibadan GC 997B

C—Ibadan C/36/95

E—Ibadan CH28

H—Minna GC 997B

TABLE 22.—CASSAVA CLONES YIELD TRIAL (LBS. TUBERS/ACRE)

<i>Variety or Clone</i>	<i>A8(50)</i>	<i>A12(51)</i>	<i>A11(52)</i>	<i>Average</i>
CH 50	13,407	19,219	7,783	13,469
B 18	10,959	17,451	7,068	11,826
Dan Warri	8,857	19,421	6,798	11,692
E 2	12,944	13,807	8,032	11,594
C 15	13,309	13,161	5,888	10,786
B 17	12,715	12,678	4,191	9,861
C 5	9,843	14,828	4,424	9,692
Two Cent	10,794	13,398	4,390	9,527
H 1	6,001	15,193	4,858	8,684
CH 28	8,519	11,504	5,715	8,579
C 23	3,011	11,386	7,045	7,147
B 26	—	7,480	4,306	5,893
B 21	8,107	7,323	1,890	5,779
A 2	—	5,428	4,478	4,953
B 9	5,000	4,593	3,602	4,398
Sig. diff. 5 per cent	4,756	5,901	2,021	—
Sig. diff. 1 per cent	6,422	7,860	2,691	—

Results in 1952-53 were statistically significant and confirm the relative positions of the top yielders of previous trials. It would appear that except for B 18 and E 2 none of the Samaru clones are equal in yielding capacity to CH 50 or Dan Warri. The trial is being repeated.

(c) *Cassava Length of Cuttings Observation*.—Further observation tests were made on cuttings of Dan Warri Cassava *ex-Zonkwa*. The cuttings were cut to lengths of 6", 9", 12" and 15" and planted in the normal way. Yields recorded from these cuttings are shown below and are compared to results obtained last year:

			1951-52	1952-53	<i>Average</i>
15"	...	...	12,928 lbs/A	11,272 lbs/A	12,100 lbs/A
12"	...	...	13,635 "	10,484 "	12,060 "
9	...	...	8,888 "	9,999 "	9,444 "
6"	...	...	12,827 "	6,515 "	9,671 "

1952-53 results show a direct increase of yield as length of cutting is increased. It would appear that 12' cuttings are the most economical size to use although yields may be higher when 15" lengths are used. The trial is being repeated.

The question of optimum length of cuttings is of importance because in this region the over-ground growth of cassava is much lighter than in the South. The multiplication of a variety is therefore very slow, and it is necessary to use the shortest satisfactory length of cutting.

INTRODUCTIONS

During the year under review, a total of 287 plant introductions were received at Samaru. These introductions included:

No.	Description	Source
8	Grass species	Australia
2	Lucernes... ..	Australia
77	Sorghums	Gambia
11	Rama (<i>Hibiscus cannabinus</i>)	Swaziland
21	Grass species	Kenya
5	<i>Urena lobata</i>	Belgian Congo
11	Sugar Cane	South Africa
14	Lucernes... ..	United States of America
21	Groundnuts	United States of America
3	<i>Lespedeza spp.</i>	United States of America

The majority of these introductions were ordered for specific purposes but quite a few are unsolicited gifts.

NURSERY WORK AND ORCHARD

(a) *Ornamental Plants*.—The demand for ornamental shrubs and trees has been heavy and shipment have been made to Zaria, Kano, Katsina, Niger and Plateau provinces. New compounds at Samaru have been planted up and avenue hedges and trees have been maintained.

(b) *Vegetable Trials*.—The series of observation trials on imported vegetables continues. Useful information is being obtained and varieties not suitable to Northern Nigerian conditions are being discarded.

It is hoped that a report giving recommendations will be prepared by the end of 1954.

(c) *Citrus and Other Fruits.*—(i) *Propagation.*—The demand for budded fruit trees of all kinds is increasing each year and many requests have to be turned down by this section. The numbers of stock seedlings are being increased to enable us to bud more trees.

A number of citrus stocks were budded in January 1954 and results are encouraging. It is hoped that dry-season budding will be increased in the future as it has been found that seedlings budded in January-February can be transplanted in July of the same year. This procedure eliminates one whole year in the nursery and will give us more working space as well as a quicker turn over.

Budding of mangoes is not as successful as that of citrus. The percentage of “takes” occasionally drops below 50 per cent. To determine whether any type or variety of bush mango is superior to any other as stock, it is proposed to plant seeds of different types separately in 1954. Observations in 1955, based on the number of “takes” will determine which, if any, variety is superior.

Propagation of Avocado pears has not proved successful to date and it has been found difficult to raise seedlings. The main cause of trouble has been the water-logged condition of the soil and a new site will be chosen in 1954.

Bud wood of mango and avocado varieties has been ordered from South Africa and it is hoped that the material will be received later this year.

(ii) *Harvesting of Fruits.*—Records of weight and numbers of fruits harvested are taken and recorded. These figures cannot be accepted as completely accurate due to thefts. Materials have been ordered from the United Kingdom for construction of a higher barbed wire fence and a new road has been made to divert traffic away from the orchard and nursery. It is hoped that these measures will discourage petty thieves.

(iii) *Fertiliser Experiment.*—An experiment is being conducted with the co-operation of the Chemistry Section on the application of nitrogenous fertilisers on citrus. Details of treatments are discussed in Chemist's section of this report.

(iv) *Analysis of Citrus Juice.*—The Chemistry Section has undertaken a series of tests on the juice of oranges and grape-fruits of certain trees in the orchard. The tests cover the whole harvest period and give us a good indication of optimum time of harvest for each variety. Details are supplied elsewhere by the Chemist.

LABORATORY EXPERIMENT.—USE OF COLCHICINE ON GUINEACORN AND SOYA BEANS

Reports in recent literature indicate that Colchicine may be used to change the genetic make up of certain plants by re-arrangement of chromosomes. The procedure does not involve the doubling of chromosomes, the usual use to which colchicine has been put.

A series of tests were conducted in the laboratory using the following varieties of Guineacorn and Soya beans.

<i>Guineacorn</i>	<i>Soya beans</i>
Redland	Black Matted Java
Ladore	Avoyelles
Farafara	Bilomi No. 1
Short Kaura	Benares
Light Mori	E.B. 28

The colchicine solutions used were 0.05 per cent and 0.2 per cent and length of treatment ranged between five and six hours. By multiplying the strength of solution by the time a SxT factor was obtained. This figure gives an indication of the "strength" of treatment and varied between 0.25 and 1.2

A total of thirty-three guineacorn seedlings and twenty-four soya bean seedlings were treated. All seedlings were between nine and eleven days old.

Four of the guineacorn and three of the soya seedlings died after treatment. All others survived and were grown in a complete nutrient sand culture in the laboratory for about twenty days before being transplanted to a small plot of land.

After being transplanted a further twelve Guineacorn and two Soya bean plants died. Of all the plants treated, the most susceptible variety was found to be Short Kaura guineacorn. Of six plants treated, only one survived.

All plants which survived transplanting grew to maturity and in the majority of cases appeared quite normal. Some of the soya bean plants, however, were distorted. Seeds of all plants were harvested and will be sown in 1954. Any effects of colchicine treatment should then become apparent.

STOCK PLOTS

The area taken up by our stock plots increases every year as more varieties of all crops on the still "Not Discarded" list are added through selection or introduction. Most varieties are retained on a minimum maintenance basis but the more promising ones are put into bigger plots to provide pure seed for experiments at Samaru or for outstations' farm garden plots. Larger scale multiplication of already established varieties continues. Seed from these multiplication plots is used for experiments at Samaru and outstations and to form the nucleus of distribution schemes in the provinces.

PESTS AND DISEASES

(a) *General*.—It has been possible this year to undertake a limited amount of pathological work and it is intended that in due course a Plant Pathology Section will be established.

It is now possible tentatively to identify plant diseases at Samaru although we must still rely on experts in Ibadan and the United Kingdom for positive diagnosis in many cases.

(b) *Red Rot of Sugar Cane*.—The spread of red rot disease of sugar cane (*Colletotrichum falcatum*) continues and it has now been confirmed that it is present in all cane growing areas except Sokoto West and Benue Province.

The damage caused by the disease was less than in previous years but reports indicate that it is still of major importance having reduced the tonnage of sugar considerably in certain districts, both directly and by discouraging planting.

Cultures of different strains of the fungus are being prepared at Samaru for inoculation into all existing and newly introduced varieties of sugar cane.

The newly introduced varieties of cane said to be resistant to Red Rot are being multiplied at Samaru and Maigana.

(c) *Groundnut Diseases*.—This has been a very poor year for groundnuts in parts of Niger Province due to damage caused by Rosette disease. The Groundnut Farm at Kontagora and the Resettlement Scheme in the same district were severely affected and in some cases the yields were reduced to nil. The only groundnuts which yielded reasonably quantities of nuts were those planted early. This might be expected as the only counter-measures we have at the moment are early planting and close spacing.

A variety of groundnuts, said to be resistant to Rosette, has been introduced from East Africa. This variety, Mwitunde, will be grown at Samaru and in Niger Province to observe its performance when planted early and late, in comparison with that of some of our local varieties and selections. Should Mwitunde confirm its resistance to Rosette, under conditions in Nigeria, it will be subjected to a programme of selection and be used in our hybridization work.

Other Groundnut diseases reported during the year were the usual leaf spot (*Cercospora personata*) and root rot (*Sclerotia rolfsii*). These two plant diseases are present every year throughout the Region but while the former seldom causes much damage, the latter may reduce yields considerably in localised areas.

Blind nuts have been reported on groundnuts in various parts of the North but it is not known at the moment whether these are caused by nutritional, physiological or pathological factors. The two former are considered more likely.

(d) *Maize Rust*.—Work on this disease is conducted by the West African Maize Rust Research Unit in Ibadan. We have co-operated with this Unit by providing facilities at Samaru and several stations have conducted observation trials on the disease. A Dry Season observation trial at Samaru developed no rust at all.

(e) *Guineacorn Diseases and Pests*.—Damage caused by covered smut was extensive in some fields of Short Kaura at Samaru. The disease is found throughout the Region and propaganda was given out at Agricultural Shows by means of demonstration of Copper Carbonate treatments. Samples of this compound were sold at shows and all stations have been issued with supplies.

Borers were particularly bad on later planted crops of guineacorn at Samaru. As a preventative measure for next season, all stalks on the farm were burnt.

The controversy over damage caused by *Striga* continues. Damage was reported at Bida on the Tractor Unit Farm. It is the opinion of the writer that *Striga* causes extensive damage only where guineacorn is planted on land of low fertility and where there is a truly heavy infestation of the parasite. Where the soil is fertile the guineacorn is able to "get away" from the parasite and does not suffer appreciably. The corn provides enough shade to hamper the growth of the *Striga*. Where the corn is stunted and weak, however, it would appear that *Striga* is able to reduce yields to practically nothing. There is moreover some evidence that "*Striga senegalensis*" in the Middle Belt may be more virulent than "*Striga senegalensis*" at Samaru, and the systematy of Nigerian *Strigas* requires further investigation.

(f) *Citrus Diseases and Pests*.—The main causes of concern have been gummosis, chlorosis (either nutritional or physiological) sooty mould, infestation by carpenter ants, water-logging and drought in the dry season,

All of these problems are receiving some attention.

(g) *Cassava Diseases*.—The problem of mosaic resistance is still with us and varieties which have in the past been considered “clean” have come down with mosaic. The fact that infected varieties often yield as well or better than “clean” strains is a problem which has yet to be solved.

A “wilt” on cassava, which has not yet been identified, caused considerable damage to experimental plots at Samaru and will prevent us from carrying out statistical experiments next year as there may only be sufficient material for maintenance and multiplication.

(h) *Other Diseases and Pests*.—Various samples of diseased plants have been sent in or reported from the Region. These include disease or pests on:

Tobacco	Yams
Rama	Pawpaw
Benniseed	Onions
Cowpeas	Tomatoes

B.—WORK AT OUTSTATIONS POLICY (A.R.M.)

The Botanists are responsible for testing of varieties of crops on out-stations in the Northern Region. Variety trials on all crops except cotton are originated either by the Botanists or by Provincial Agricultural Officers but final decisions on all experiments are made at the Cropping Schemes Committee meetings.

Before any given variety is included in a variety trial the following general procedure is usually followed: if it is a newly bred or introduced variety it will first be grown at Samaru for observation and multiplication. It is then sent to stations where it is believed it may be suitable. At these stations it is grown in “Farm Gardens” and its general performance in small plots is recorded. If its yield and general characteristics are considered suitable, it is included in a series of variety trials. If it proves itself superior in one or more factors to the commonly used varieties, after passing through all the above stages, it may be recommended for general distribution in a given area. The actual multiplication and distribution is the responsibility of Provincial Agricultural Officers but the Botanist undertakes to supply a small nucleus stock of pure seeds each year for these multiplication schemes.

GROUNDNUTS (C.W.M.)

General.—Results of trials at outstations in 1953 proved very disappointing. Eight outstations in all were concerned, but at four of them the groundnut trials for one reason or another were a complete failure and were not analysed.

In farm gardens at the outstations a total of 53 groundnut varieties were tried out.

(1) *Kano*.—The variety trial at Kano KR4 (53) was to have been carried out in 1952; however soon after planting in that year it was discovered that the seed had been hopelessly mixed and the experiment was abandoned and repeated in 1953. This year's results were positive and proved interesting in that both MK 383 and MK 374 gave significantly better yields than Kano 50 and Local Spreading. Both MK 383 and MK 374 also gave higher yields of haulms than Kano 50 (an important aspect in the Kano area). The result is interesting in that Kano 50 is the recommended variety for the Kano area.

The experiment is to be repeated next year. Yields are presented in Table 23.

TABLE 23.—GROUNDNUT VARIETY TRIAL, KANO.

<i>Variety</i>	<i>Yield of kernels lb. per acre</i>	<i>Yield Haulms lb. per acre</i>
MK 383	1,261	1,103
MK 374	1,227	1,078
Kano 50	1,064	1,010
Dixie Runner	1,051	936
Local Spreading	874	949
Natal Common	621	1,178
Spanish 205	540	499
S.E.	50	—
5 per cent sig. diff.	143	—
1 per cent sig. diff.	193	—
0.1 per cent sig. diff.	255	—

(2) *Bida*.—The result of a trial at Bida in 1952 comparing Botanist Castle Cary and Samaru 38 with Bida strains of same varieties was to have been followed up by a repeat in 1953. Unfortunately the trial was a failure largely due, as shown by the germination figures, to the practice of using seed from nuts shelled at previous harvest. The first germination count was 62 per cent and of these many of the plants were stunted and of poor appearance. The results were not analysed.

(3) *Daura*.—This experiment was the final one of a series comparing the yields of various varieties under Daura conditions. The result confirms beyond doubt that we have nothing at the moment that can compare with Local Spreading under Daura conditions. During the six years that the experiment has run Daura Local Spreading has given the highest yield on four occasions, second highest once and fourth highest once.

This year's yields together with a comparison of previous years' results and stand counts are given in Tables 24 and 25. It will be seen that the relative lack of success of non-local varieties cannot yet be definitely dissociated from poor stand counts, and poor establishment has been the rule throughout these trials.

TABLE 24.—GROUNDNUT VARIETY TRIAL, DAURA (LB KERNELS PER ACRE)

<i>Year Variety</i>	1953 ***	1952 *	1951 ***	1950 ***	1949 **	1947 **
Local Spreading	803(1)	370(4)	907(1)	613(2)	559(1)	374(1)
M'Putu D	559(2)	277(8)	308(8)	29(8)	256(6)	190(5)
MH 375	550(3)	351(6)	329(6)	143(5)	409(2)	283(3)
MH 382	544(4)	—	—	—	—	—
Gusau Semi Upright	533(5)	408(1)	466(3)	130(6)	360(5)	158(7)
Kano 50	519(6)	—	—	—	—	—
Castle Cary	363(7)	353(5)	396(4)	710(1)	—	—
Bagobira	333(8)	379(2)	475(2)	183(4)	375(4)	190(5)
S.E.	41	25	38	32	17	17
5 per cent sig. diff.	118	81	109	93	48	49
1 per cent sig. diff.	158	—	146	124	65	67
0.1 per cent sig. diff.	209	—	194	164	—	—

TABLE 25.—GROUNDNUT VARIETY TRIAL, DAURA PER CENT STAND AT HARVEST

Variety Year	Local Spreading	M'putu D	MH 375	MH 382	Gusau Semi Upright	Kano 50	Castle Cary	Bagobira
1949	39.7	40.5	15.4	—	30.9	—	—	43.7
1950	71.6	25.3	14.9	—	13.5	—	88.6	18.4
1951	41.9	25.9	13.5	—	16.6	—	22.5	18.9
1952	86.7	70.3	80.2	—	81.6	—	76.8	82.8
1953	91.4	83.6	83.2	78.9	78.3	91.0	65.9	48.0
Average	66.3	49.1	41.4	(78.9)	42.2	(91.0)	63.5	42.4

(4) *Zonkwa*.—Unfortunately fire destroyed harvested nuts at Zonkwa before they could be weighed and so it was impossible to follow up this year the results of the 1952 experiment.

(5) *Yola*.—Trials at Yola in the past have almost always proved inconclusive, the 1953 trial was no exception giving poor yields and insignificant results. It seems that the soil at the Yola centre is extremely variable and in 1953 rosette and other diseases were appreciably more prevalent too. Indeed some plots had as few as forty-two health plants out of a possible total of 240 (*See* Table 26).

This trial is now to be discontinued.

TABLE 26.—GROUNDNUT VARIETY TRIAL YOLA (LB PER ACRE)

Year	1953		1952
Treatments	KERNEL (Insignificant)	HAULMS (Significant)	KERNEL (Insignificant)
Kano 50	420	1,516	—
Castle Cary	400	1,150	495
Verre Upright	394	1,150	602
Natal Common	390	652	466
MK. 383	382	1,370	—
MJ. 371	326	1,131	—
S.E.	±42	±69	±54
5 per cent sig. diff. ...	—	202	—
1 per cent sig. diff. ...	—	274	—
0.1 per cent sig. diff. ...	—	365	—

(6) *Yandev*.—The trial at Yandev was a failure in 1953 and was not analysed, the average yield of kernels being 89 lbs per acre due largely to Rosette attack which was considerable. The tendency in 1952 was for the early maturing varieties such as Spanish 205 to out-yield the late maturing types such as Castle Cary and despite extremely poor yields this tendency was again evident in 1953 and even emphasised by the heavy Rosette attack.

(7) *Gusau*.—This variety trial comparing three varieties of Groundnuts with "Gusau" type was continued. Natal Common which had not proved its worth was dropped and Local Spreading substituted for it. There were no significant differences this year but Kano 50 yielded less than Castle Cary for the first time in three years.

The indications that our present selections are not constantly superior to Gusau seems to have been confirmed. This being so it is intended to try a new line of selections in the farm garden this year and if they appear to do reasonably well they will go into full trial in 1955.

Yields are presented in Table 27.

TABLE 27.—GROUNDNUT VARIETY YIELD TRIAL, GUSAU
(LB KERNELS PER ACRE)

Year Varieties	1953	1952	1951
	Not. Sig.	Sig. ($P=1\%$)	H.Sig. ($P=0.1\%$)
Gusau	704	1,145	693
Castle Cary	703	1,065	813
Kano 50	662	1,100	960
Local Spreading	603	—	—
Natal Common	—	960	415
S.E.	± 37	± 35	± 40
5 per cent Sig. Diff.	—	102	119
1 per cent Sig. Diff.	—	139	162
0.1 per cent Sig. Diff.	—	—	220

(8) *Kontagora*.—The variety trial this year was a complete failure due to extremely heavy Rosette attack. It is hoped that, by means of earlier planting, a more successful repeat trial will be possible in 1954.

GUINEACORN (E.H.)

(a) *General*.—Variety Trials on guineacorn at outstations are usually tests of selections from local varieties by Provincial Agricultural Officers.

Dr. Webster's sorghum varieties have been tried in several areas in farm garden observation plots. As at Samaru, Ladore and Hegari are the most promising varieties to date.

(b) *Gusau (Sokoto Province)*.—A variety yield trial GR3 (52) 53 has been carried out for the last two years to compare the yields of five local varieties See Table 28.

TABLE 28.—GUINEACORN VARIETY TRIAL, GUSAU (LB GRAIN PER ACRE)

Variety	1952	1953
Farafara (compact panicle)	1,067	1,351
Farafara (loose panicle)	1,291	1,318
F.C. Standard (loose panicle, Kaura)	1,094	1,299
Budin Saniya (compact panicle, Kaura)	1,093	1,270
Kwar biyu (2 seeded, White grain)	1,340	1,186

There are no significant differences in yield. The varieties all yield well but their performance varies in different seasons.

A guineacorn strain test GR1 (52) 53 was carried out in 1950-53 to compare the yields of various selected strains of Farm Centre Standard with local farmers' unselected Tall Kaura. See Table 29.

TABLE 29.—GUINEACORN STRAINS TEST, GUSAU, (LB GRAIN PER ACRE)

<i>Treatments</i>					1950	1951	1952	1953
1.	10 best progenies	...	...	...	1,374	1,014	750	803
2.	10 worst progenies	...	...	...	1,217	994	767	842
3.	Mass selected F.C. Standard	...	...	...	1,244	1,134	765	879
4.	Unselected F.C. Standard	...	...	...	1,224	1,111	785	794
5.	Unselected local farmers'	...	...	...	1,391	650	569	833

There are no significant differences in yield. The selections all originated from one open-pollinated head and it seems likely that the selections are being made from material with insufficient variation to show good results. As no selfing is carried out and single plant rather than progeny-row selections are made in treatments 1 and 2 dilution or soil fertility differences would account for the results here. The mass selection method is the most reliable.

(c) *Daura (Katsina Province)*.—A guineacorn variety trial DR2 (52) 53 to compare the yields of six local varieties was carried out in 1951, 1952 and 1953. See Table 30.

TABLE 30.—GUINEACORN VARIETY TRIAL, DAURA, (LB GRAIN PER ACRE)

<i>Varieties</i>					1951	1952	1953
Buturi Futa	...	...	...	...	705	353	374
Kaura	...	...	...	...	773	257	569
Jar Kaura	...	...	...	...	670	411	358
Farar Kaura	...	...	...	...	1,082	364	563
Sheto	...	...	...	...	822	354	515
Farafara	...	...	...	...	1,013	321	454
5 per cent Sig. Diff.	...	...	...	...	147	—	233
1 per cent Sig. Diff.	...	...	...	...	—	—	316

Farar Kaura is the only consistently good yielder over the three years.

OTHER CROPS (A.R.M.)

SOYA BEANS

(a) *General*.—Interest in Soya Beans has been renewed during the year and efforts are being made to establish varieties in the Kontagora Division of Niger Province. It may be found suitable as a cash crop in parts of the province where groundnut culture is uneconomic due to the prevalence of Rosette disease.

Soya beans are well established in Benue Province and are grown after Benniseed.

Although results in 1952 were very promising at Riyom, the 1953 trial had to be cancelled due to re-organisation at that farm.

(b) *Yandev (Benue Province)*.—The 1952 trial was repeated in 1953 but was unfortunately sited on a very poor field and yields were disappointingly low. The results of the 1953 Trial VR2 (52) 53 are compared in Table 31 with those of the previous year.

TABLE 31.—SOYA BEAN VARIETY TRIAL, YANDEV,
(LB THRESHED BEANS PER ACRE)

<i>Variety</i>	1952 (<i>position</i>)	1953 (<i>position</i>)	<i>Average</i>
Malayan	834 (1)	366 (1)	600
Bilomi No. 3	724 (3)	315 (3)	520
Yellow Bermeley	760 (2)	271 (5)	516
Black Matted Java	672 (4)	249 (6)	461
28 E.B.	614 (7)	273 (4)	444
Misc. 94	543 (9)	322 (2)	433
Benares	648 (5)	216 (8)	432
Dixie	624 (6)	225 (7)	425
Bilomi No. 1	555 (8)	214 (9)	385
S.E.	±48	±23	
S.D. 5 per cent	135	65	
S.D. 1 per cent	180	87	
S.D. 0. 1 per cent	—	114	

It appears, from results to date that Malayan and Bilomi No. 3 are the most consistent performers. They are certainly superior to Benares and Dixie which have been used at Yandev before and which have been distributed to farmers in the province.

If results in 1954 are similar to the above the Agricultural Officer will be advised to begin a multiplication scheme.

RICE

G. 79 Multiplication Schemes.—The careful roguing of *G. 79* Rice has continued at Samaru and Maigana and the purity of seed being distributed from Maigana has greatly improved. The Stage O rice had only 1 per cent impurity while the Stage 1 had 4.33 per cent off-types. This compares very favourably with the figures obtained in 1952 when a percentage of 65.7 off-type seeds was found in the Maigana *G. 79* rice. It would appear that we have brought the situation under control.

The following table shows results of purity tests conducted at Samaru on samples of *G. 79* rice sent in by various stations in the Region.

<i>Station</i>	<i>Percentage impurity</i>
Maigana Stage O	1
Maigana Stage 1	4.33
Yola Sample I	16
Yola Sample II	18
Shemanker <i>G. 79</i>	3.66
Bauchi—(Ahmed Kiri)	0.66
Bauchi—(Inkil farm)	6.0
Ilorin— <i>ex</i> Shonga	6.3
Ilorin— <i>ex</i> Lafiagi	3.0
Yandev	1.3
Maiduguri	3.67

SUGAR CANE

Variety trials with sugar cane have been undertaken at Maigana (Zaria Province) for several years but results have not yet been satisfactory due to such factors as attacks by termites, Red Rot disease and shortages of planting material when required.

Results of the 1952-53 trial are shown in Table 32 and are the first available. There was no trial in 1953 due to the reasons mentioned above.

The trial included seven varieties of sugar cane in comparison with the local variety. These Varieties were:—

- | | |
|----------------------------|-----------------------------|
| (1) Local | (5) Var. No. 5 BOT. No. 58. |
| (2) Var. No. 8 BOT. No. 61 | (6) Uba BOT. No. 64 |
| (3) CO. 213 BOT. No. 65 | (7) Var. No. 4 BOT. No. 57 |
| (4) CO. 331 BOT. No. 68 | (8) Var. No. 3 BOT. No. 56. |

Due to the incidence of Red Rot Disease, the local variety and Var. No. 3 failed to produce a good stand and were not included in the analysis of the experiment.

TABLE 32.—SUGAR CANE VARIETY TRIAL, MAIGANA
(LB PER ACRE AND PERCENTAGE SUGAR)

<i>Variety</i>	<i>Bot. No.</i>	<i>Cane Yield</i>	<i>Cane Sugar</i>	<i>Percentage Sugar</i>
Uba	64	20,025	1,280	6.4
CO. 331	68	21,280	854	3.5
CO. 213	65	14,520	784	5.4
Var. No. 8	61	13,269	713	5.4
Var. No. 4	57	14,762	607	4.1
Var. No. 5	58	12,523	462	3.7
S.E.			±142	
S.D. 5 per cent			414	

The results show that Uba variety out-yielded all the other varieties significantly ($P=0.05$) on the basis of the yield of cane sugar per acre. No other significant differences occurred.

BENNISEED—(SESAMUM INDICUM)

(a) *General*.—As in past years, all selection work and yield trials were carried out at Yandev. The aim of the selection programme is to develop strains of (a) earlier maturing plants, i.e., plants reaching maturity within 89-100 days, and (b) heavier yielding plants.

Results to date are encouraging and it is hoped that improved strains under both the above heads will be available for distribution in the near future.

Further selections were made in 1953 and these will be planted this year (1954).

(b) *Early selections, Family and Strains Trial.*—This trial consisted of strains reselected in twelve families from single plants selected originally in 1949 for early maturity and apparently retaining this earliness. Strains from selections 181 and 98 were grouped as one family F, from 172 and 192 as G, from 109 and 167 as H, from 120 and 4 as J, and Yandev unselected as U. Selection 66 with twelve strains was split into two—Families D and E. Selections 189, 137 and 152, became families A, B and C respectively to give (with Yandev Unselected) ten families.

There were six randomised blocks of the ten families each consisting of six strains.

Analysis of results was done on the basis of:—

- (a) Yield.
- (b) Relative earliness.

To determine the earliness on a numerical basis, the percentage of mature plants was taken at the time when the first few plants of Yandev unselected benniseed (planted at the same date) were beginning to reach maturity.

Analysis of yields of strains within families was performed and significant differences were found in families A, B, F, H and J.

The analysis between families on the basis of yields gave the results shown in Table 33.

TABLE 33.—BENNISEED EARLY SELECTIONS TRIAL, YANDEV
(LBS SEED PER ACRE)

<i>Family</i>					1953	1952
A	...	...	...	...	125	374
B	...	...	...	...	117	280
U	...	...	...	...	94	293
E	...	...	...	...	82	272
D	...	...	...	...	80	299
H	...	...	...	...	74	347
F	...	...	...	...	73	259
C	...	...	...	...	71	265
J	...	...	...	...	70	311
G	...	...	...	...	55	236
5 per cent Sig. Diff.					18.4	68.35
1 per cent Sig. Diff.					24.5	91.45

Although results were significant, only two families, i.e., A and B yielded better than Yandev unselected (at $P=.01$ and $.05$ respectively). As observed in 1952, the highest yielding family was not necessarily earliest in maturity.

Table 34 shows the percentage maturities obtained for the various families and these were analysed after angular transformation.

TABLE 34.—BENNISEED (EARLY SELECTIONS—PER CENT MATURITY)

1952				1953			
<i>Family</i>	<i>% Mature plants</i>	<i>% Trans- formed to degrees</i>	<i>Average No. of days to full maturity</i>	<i>Family</i>	<i>% Mature plants</i>	<i>Trans- formed to degrees</i>	<i>Average No. of days to full maturity</i>
F	47.5	43.6	99.2	B	36.9	37.4	105
B	42.0	40.4	92.2	H	16.3	23.8	105
C	21.3	27.5	94.6	F	13.1	21.2	105
J	11.9	20.2	96.9	C	6.8	15.1	105
D	11.7	20.0	96.6	A	6.2	14.4	105
H	11.3	19.7	93.3	D	4.3	11.7	105
E	10.7	19.1	97.5	G	3.7	11.1	105
G	10.4	18.8	97.0	E	3.5	10.7	105
A	6.8	15.1	98.0	U	2.0	8.1	112
U	2.6	9.2	104.0	J	1.3	7.5	105
Sig. diff. at 5%		13.5				9.19	
Sig. diff. at 1%		18.1				12.27	

All strains reached maturity in a longer time than last year. This may be attributed to the lateness of the "short dry" spell in August and to heavy rains and overcast skies during the period of growth.

Strains B, H, and F were found to be significantly earlier than Yandev Unselected and strain J ($P=.01$).

Strains B and F have been within the top three strains in earliness for two years now and it would appear that they are definitely retaining this characteristic.

Table 35 compares results obtained in 1952 and 1953.

TABLE 35.—BENNISEED EARLY SELECTIONS, YIELD AND MATURITY DATA

1952				1953			
<i>Order</i>	<i>Earliness</i>		<i>Yield lbs/ac.</i>	<i>Earliness</i>		<i>Yield lbs/ac.</i>	
1st	F	43.6	A 374	B	37.4	A	125
2nd	B	40.4	H 347	H	23.8	B	117
3rd	C	27.5	J 311	F	21.2	U	94
4th	J	20.2	D 299	C	15.1	E	82
5th	D	20.0	U 293	A	14.4	D	80
6th	H	19.7	B 280	D	11.7	H	74
7th	E	19.1	E 272	G	11.1	F	73
8th	G	18.8	C 265	E	10.7	C	71
9th	A	15.1	F 259	U	8.1	J	70
10th	U	9.2	G 236	J	7.5	G	55

It would appear, from the above results, that family B is the most promising when both earliness and high yielding capacity are compared.

(c) *Normal Maturity Benniseed Yield Trial*.—Another trial of the two strains A—(055) and B—(064) selected and tested in 1952 was carried out in 1953 and another strain C—(0361) selected from the 1952 plots was included. These strains have maintained the desirable heavy yielding character since 1949. Yandev unselected 'D' was included as a control.

The layout was as in 1952, i.e., a simple randomised block of 9 replications, and yields are shown in Table 36.

TABLE 36.—BENNISEED YIELD TRIAL, YANDEV, (LB. SEED PER ACRE)

<i>Strains</i>					1953	1952
064	...	...	...	...	275	453
055	...	...	...	...	234	501
(Yandev Unselected)				...	230	428
0361	...	...	...	...	230	—

The results obtained were insignificant as last year, but strains 064 and 055 yielded higher than the Yandev Unselected.

PART IV.—CHEMISTRY SECTION

By H. Irving and G. M. Higgins

LABORATORIES

There have been no new additions or alterations to the laboratory buildings during the past year. Considerable new electrical equipment has been received for use with the 230 volt supply when the station is connected to the Zaria supply of the Nigeria Electricity Corporation. The new apparatus will increase the capacity of the laboratories for some types of analyses by as much as 100 per cent, and will in addition, enable types of analysis previously not possible, to be carried out in the laboratory.

CHEMICAL ANALYSIS

With the additional staff, the actual number of determinations carried out in the laboratory was greatly increased over the previous year. The majority of the laboratory work has been carried out in connection with other projects and not solely as a chemical study, e.g., over 400 samples for the Pasture Research Section, Gamba grass samples for Agricultural Officer, Kano, and soil samples for the surveys carried out; the results of these major analyses are described in the reports of the officers concerned. Numerous routine samples such as cattle dips, feeding stuffs, F.Y.M., plant material, soils and fertilisers were also analysed throughout the year.

EXPERIMENTAL WORK

(1) *Standard D.N.P.K. Trials.*—The standard series of trials incorporating annual dressings of F.Y.M. with Nitrogenous, phosphatic and Potassic fertilisers continued at Daura, Kano, Daudawa, Samaru, Bida, Yandev and Maiduguri, with the current phase of the local rotation. Responses due to the higher levels of the four main factors are shown in Table 37.

TABLE 37.—D.N.P.K. TRIALS: ALL STATIONS

Station	Crop	Responses in lbs/acre to dressings per acre of			
		2 tons F.Y.M.	100 lbs. super phosphate	100 lbs. sulphate of ammonia	50 lbs. muriate of potash
Daura	G'corn plus				
	Millet	+152***	+67**	+40	+16
Maiduguri	Millet	+241***	+283***	+89	+81
Kano	G'corn	+682***	+17	+478**	—36
Daudawa	Cotton	+179***	+58**	+91***	+11
Samaru	Cotton	+204***	+81**	+80**	+10
Bida	G'corn	+466***	+390***	+223***	+15
Yandev	Yams	+1188**	+335	+1331***	—1515***

For the first time since the start of these trials a suggestion of detrimental effects from heavy dressings of superphosphate over the smaller dressings has been observed, the stations concerned being Yandev and Kano. Full superphosphate results for these two stations are shown in Table 38.

TABLE 38.—D.N.P.K. TRIALS, YANDEV AND KANO
RESPONSES TO SUPERPHOSPHATE

Station	Crop	Unit	Superphosphate dressing		
			Nil	50 lb/ac.	100 lb/ac.
Yandev	Yams	lb/ac. tubers	12,105	13,430	12,440
Kano	G'corn	lb/ac. grain	981	1,027	998
	Ditto (N absent)		959	845	771

At Yandev, 50 lb/acre of superphosphate gave a yield significantly better ($P=.001$) than nil and ($P=.01$) than 100 lb/acre. 100 lb/acre dressing gave no significantly greater yield than no superphosphate.

At Kano, there was no significant difference in the overall means at any level of superphosphate, but on the plots where Nitrogen was absent, there was a marked downward trend with increasing superphosphate.

No detrimental effects have as yet been observed at other stations, results confirming that the large responses to F.Y.M. in Northern Nigeria are mainly due to its phosphate content, and that so far no response has been obtained anywhere to potash.

(2) *Sulphur Deficiency*.—During 1953 an all station trial was laid down which was designed to determine the response of groundnuts to:

1. 60 lb. superphosphate/acre.
2. 20 lb. of triple superphosphate.
3. Gypsum at a rate equivalent in sulphate content to Treatment 1.

From the results of these trials it was hoped to construct a two way table of results as shown below.

	O	P
	Nil Gypsum	Triple Super Superphosphate

and thus ascertain

- (a) the relative contributions of sulphur and phosphate to the superphosphate effect, and
- (b) the areas where responses to sulphur alone might be expected, e.g., 1951 result at Kontagora where increments due to sulphate on groundnuts were +518 lbs. kernels/acre (69 per cent of no sulphate) and +1,123 lbs. haulms/acre (91 per cent of no sulphate).

Tables 39 and 40 show the 1953 results, and although the precision of the experiments was not as accurate as hoped for, the results indicated that at the majority of the stations, both sulphate and phosphate contribute to the superphosphate effect. A modified trial, designed to give increased precision will be carried out at all stations during 1954.

TABLE 39.—COMBINED YIELDS OF KERNELS (LBS. PER ACRE) FROM DAURA, BAUCHI, GUSAU, DAMBATTA, KONTAGORA, DAUDAWA AND ZONKWA

	P0	P1	Mean
S0	541	545	543
S1	591	663	627
Mean	566	604	585
Main Effect—Phosphate	+38 lb/acre.		
Main Effect—Sulphur	+84 lb/acre.		
Interaction—PxS	+34 lb/acre.		

NORTHERN BELT CROPS

A. Groundnuts: Residual Trials.—The fertiliser requirements of groundnuts in many parts of the Northern Region have previously been ascertained, and the few scattered trials carried out in 1953 confirmed these previous results, namely that on average groundnut soils (soils yielding 700 lbs. kernels per acre) an increase of 200 lbs kernels per acre can be expected from an application of 56 lbs. of superphosphate.

The main fertiliser work on groundnuts carried out in 1953 was concerned with residual effect of superphosphate, and a summary of these trials is presented in Table 41.

TABLE 41.—RESIDUAL VALUE OF SUPERPHOSPHATE ON GROUNDNUTS

Station	Super-phosphate Dressing	Year Applied	Yields of Kernels per acre in 1953			S.E. as percent of G.M.
			Nil	Super	Increment	
Samaru	60 lbs.	1952	881	934	+53	21.0
Kontagora	60 lbs.	1952	242	333	+91***	16.1
Maiduguri	60 lbs.	1952	1,334	1,334	0	5.6
Daura†	60 lbs.	1952	544	496	—48	—
Dambatta†	50 lbs.	1951	18	29	+11	—
Dambatta†	100 lbs.	1951	18	34	+16	—
Samaru	60 lbs.	1951	796	798	+2	12.5

†=Experimental Results not considered valid.

Due to the high proportion of non valid results, no conclusions can be drawn from this series of trials, which are being repeated in 1954.

B. Guineacorn: (1) Time of Application Trials.—During 1952 an all station trial was laid down designed to determine if there was any decrease in the reponse of guineacorn to superphosphate, if applied at time of thinning instead of at planting. No conclusive results were obtained from these trials due to the fact that the fertilisers were applied at 10 day intervals from planting, and not at various stages of growth. This fault was remedied in 1953 when a further trial was laid down at Samaru and Maiduguri the fertiliser being applied at planting, at the 2 leaf stage of growth, and at the four leaf stage.

While the results of these trials (Table 42) show no significant differences between the dates of application, there was in each case a trend of increasing yield with later application. This trial will be repeated on a wider scale in 1954.

TABLE 42.—TIME OF APPLICATION OF SUPERPHOSPHATE TO GUINEACORN, MAIDUGURI AND SAMARU (LB. GRAIN PER ACRE)

Experiment No.	Maiduguri	Samaru
No Manure	660	993
60 lb. super/acre applied at planting	971	1,044
at 2 leaf stage ...	991	1,058
at 4 leaf stage ...	1,046	1,094
S.E. as per cent of G.M. ...	20.9	12.3
Difference required for 5% Sig. Diff.	228	—

(2) *Fortified F.Y.M. Trials.*—The results from two trials carried out in 1953 at Samaru and Yola are shown in Table 43. The present year's results do not agree with the one quoted last year, for although the incorporation of superphosphate during the making of F.Y.M. has produced a slightly better product, the addition to the field of normal F.Y.M. plus the same amount of superphosphate has given slightly higher yields still. These differences are not significant, but there is no evidence yet to show that it is worth while fortifying F.Y.M. during its making. In the present cases, in fact, one would have expected a greater total return from the application of the normal F.Y.M. to one field and of the superphosphate to another.

TABLE 43.—FORTIFIED F.Y.M. TRIALS, SAMARU AND YOLA
(LB. GUINEACORN GRAIN PER ACRE)

<i>Treatment</i>	<i>Samaru</i>	<i>Yola</i>
1. No Manure	969	439
2. 3 tons/acre Normal F.Y.M. ...	1,199	565
3. 3 tons/acre Fortified F.Y.M. (containing x lb. superphosphate) ...	1,142	599
4. x lb. per acre Superphosphate ...	994	502
5. 3 tons Normal F.Y.M. + x lb. Superphosphate/acre	1,229	681

x=94 lbs. at Samaru and 327 lbs. at Yola.

(3) *Residual Trials.*—Trials designed to ascertain the residual effects on guineacorn, of F.Y.M. and phosphatic fertilisers applied in 1952, were continued at Kano and Guasu in 1953.

The Gusau results were not considered valid, the yields of the nil treatment varying from 103 to 1,174 lbs. of threshed grain/acre.

The results from Kano, show that F.Y.M. produced the only significant residual effect; the responses being as follows:

2 tons per acre F.Y.M. — + 314 lb. grain/acre.

100 lb/ac. Superphosphate — + 100 lb. grain/acre.

Equivalent P_2O_5 in Monammonium Phosphate — + 47 lb. grain/acre.

C.—COTTON

Two fertiliser trials on cotton at Government stations were carried out during 1953, a residual trial at Zonkwa, and a Nitrogen and phosphate trial at Daudawa. Results from the former were not analysed, yields being very low and variable.

The trial at Daudawa, W6 (53), designed to ascertain the response of cotton to various rates of application of superphosphate and sulphate of ammonia, gave no significant results, a summary of yields being presented below in Table 44.

TABLE 44.—Cotton Fertiliser Trial, Daudawa
(lb Seed Cotton per acre)

<i>Treatments</i>	<i>Yield of Seed Cotton</i>
Sulphate of Ammonia	
Nil	479
50 lbs/acre	517
100 lbs/acre	496
Superphosphate	
Nil	475
50 lbs/acre	481
100 lbs/acre	536
S.E.	18.3% of G.M.

D.—TOBACCO

For the fourth year in succession of a trial designed to ascertain the effect of various combinations of nitrogenous, phosphatic and potassic fertilisers on the yield of tobacco, was carried out at Gusau.

Once again the results proved to be non-significant; even though the increases for four of the treatments ranged from 287 lbs. (14.8%) to 631 lbs. (32.7%) over nil. The non-significance of this trial is undoubtedly due to the high coefficient of variation. (29.1 % of G.M.) increases of the latter order normally being significant.

A summary of the four years results is presented in Table 45. No conclusions can be drawn from this series of trials, the results to date being extremely variable. Notable features, however, are:

- (1) the consistent response to N.
- (2) the overall slight response to K.
- (3) the overall slight response to 100 lb. P.
- (4) the consistent lack of response to the second 100 lb. of P, whether in the presence or absence of N.

TABLE 45.—FERTILISER TRIALS ON TOBACCO, GUSAU, 1950-53
(LB. GREEN LEAVES PER ACRE)

<i>Treatments</i>	1953	1952	1951	1950	<i>Mean</i>
No Manure	1,931	210	1,855	1,199	1,299
100 P	2,218	131	2,029	967	1,336
200 P	1,776	338	1,937	1,194	1,311
100 P + 50 N	2,562	206	2,235	1,353	1,589
200 P + 50 N	2,474	196	2,086	1,090	1,461
100 P + N + 25 K ...	2,239	410	2,665	1,343	1,664
S.E.	±287	±115	±161	±181	

P=Superphosphate; N=Sulphate of Ammonia; K=Muriate of Potash
25, 50, 100, 200=lbs. per acre of the fertiliser concerned.

The coefficient of variation is probably exaggerated in part by the use of green weights. This practice was adopted owing to the degree of supervision and the special storage arrangements necessary to ensure the separate drying of the various pickings of the different treatments without mistakes occurring. However, the final test is the cured leaf, and if such trials are continued, this extra work must be undertaken.

MIDDLE BELT CROPS

A. Yam: (1) Ilorin Province.—The experiments designed to ascertain the fertiliser requirements for principal food crops in Ilorin Province, continued during 1953. Three randomised block experiments with yams were laid down at each of three sites, using the same treatments as in 1952, namely the six combinations of N_0 , N_1 , and N_2 ; and P_0 and P_1 where

N_0 , N_1 , N_2 =Nil, 60 and 120 lbs/ac. Sulphate of Ammonia.

P_0 , P_1 =Nil and 60 lb/ac. superphosphate.

A summary of the yields from the three centres is presented in Table 46. It should be noted that the data used in the analysis of the results from Ballah consisted of results from two blocks only in each of the three experiments, due to a variation in planting material.

At each of the three sites significant responses were obtained to sulphate of ammonia, but not to superphosphate. A further point worthy of note is that at Ballah and Okeoyi the interaction between nitrogen and phosphate was significant ($P=.05$).

<i>Okeoyi</i>			<i>Ballah</i>					
			P_0	P_1			P_0	P_1
N_0	...	...	2,807	2,678	N_0	...	10,688	9,733
N_1	...	...	3,051	3,137	N_1	...	10,298	12,291
N_2	...	...	3,234	3,521	N_2	...	12,493	12,486
5 per cent sig. diff. requires 288 lbs.						5 per cent sig. diff. requires 1,647 lbs.		

At Ballah, nitrogen in the absence of P is only significant at the double rate, but in the presence of P is also significant at the single rate. Likewise P is only significant in the presence of single N rate.

At Okeoyi however nitrogen in the absence of phosphate increases yields, while phosphate in the absence of nitrogen tends to decrease yields. In the presence of each other the trend is to increase yields, this trend becoming significant at the 5 per cent level with the double dressing of N and the dressing of P.

The nitrogen x site interaction was also significant at Okeoyi, showing that the nitrogen effect although positive at all sites was more marked on some than on others.

TABLE 46.—FERTILISER TRIALS ON YAMS, OKEOYI, BALLAH AND PAIYE
(LB TUBERS PER ACRE)

<i>Fertiliser</i>				<i>Okeoyi</i>	<i>Ballah</i>	<i>Paiye</i>
No Nitrogen	...	...	...	2,743	10,212	3,792
Increase N_1 over nil	...	...	...	351***	1,083***	1,328***
Increase N_2 over nil	...	...	...	635***	2,278**	1,776***
Increase N_2 over N_1 ..	...	...	...	284**	1,195*	448
No phosphate	...	...	...	3,031	11,160	4,987
Increase P_1 over P_0 ...	...	...	...	81	343	—320

The overall result that sulphate of ammonia applications significantly increase the yield of yams in certain areas of Ilorin Province was confirmed in 1953 by a series of Observation Trials, carried out by Agricultural Officer, Ilorin, on farmers own land, 60 lb/acre sulphate of ammonia giving an average increase of approximately 1,000 lbs yams per acre with no further increases due to the addition of superphosphate or extra sulphate of ammonia.

(2) *Benue Province*.—In Benue Province a trial was laid down at Mbatie on the Tractor Unit Farm, designed to ascertain the levels of nitrogenous, phosphatic and potassic fertilisers required to increase the yield of yams. Two replications of a thirty-three factorial design were used, each replication consisting of twenty-seven plots made up from all combinations of the following three main treatments.

n_0, n_1 and n_2 = Nil, 1 cwt. and 2 cwts of sulphate of ammonia per acre.

p_0, p_1 and p_2 = Nil, 1 cwt and 2 cwts of superphosphate per acre.

k_0, k_1 and k_2 = Nil, 46 lbs and 92 lbs of Muriate of Potash per acre.

The results obtained, although not significant, indicated a trend towards an increase from both nitrogenous and phosphatic manuring, but not from potassic fertilisers.

A summary of yields, showing main effects only, is presented in Table 47.

TABLE 47.—FERTILISER TRIAL ON YAMS, MBATIE
TUBERS LBS/ACRE

<i>Main Effects</i>						<i>Yield</i>
<i>Sulphate of Ammonia</i>						
Nil	...	...	...	...	...	6,878
1 cwt.	...	...	...	...	...	6,822
2 cwts.	...	...	...	...	...	7,553
<i>Superphosphate</i>						
Nil	...	...	...	...	...	6,373
1 cwt.	...	...	...	...	...	7,172
2 cwts.	...	...	...	...	...	7,708
<i>Muriate of Potash</i>						
Nil	...	...	...	...	...	7,312
46 lbs.	...	...	...	...	...	7,304
92 lbs.	...	...	...	...	...	6,637
S.E. = ± 418 = 25.0 per cent of G.M.						

B. Guinea-corn and Early Maize

Ilorin Province: (1) *Response to Fertilisers*.—Guinea-corn and Early Maize were again included in the series of trials continued in Ilorin Province during 1953, designed to ascertain the fertiliser requirement of the principal food crops of the area.

Two complete experiments were laid down at each of the three centres previously used, namely Paiye, Ballah and Okeoyi, the first designed to measure the response of Early Maize interplanted with Guinea-corn to fertilisers applied to the Maize the second designed to measure the response of a direct fertiliser application to the guinea-corn

In both cases the crop receiving the direct fertiliser application responded significantly but unfortunately, due to a partial guineacorn crop failure in the area, it was not possible to substantiate the 1953 indications that when the fertiliser was applied to the maize an additional response was also obtained from the interplanted guineacorn.

A summary of the yields from the three centres is presented in Tables 48 and 49.

TABLES 48 AND 49.—FERTILISER TRIALS ON GUINEACORN AND MAIZE, ILORIN PROVINCE

Differences between Treatments and Nil Applications in lbs. of the threshed grain per acre

TABLE 48.—EARLY MAIZE INTERPLANTED WITH GUINEACORN

Site	Early Maize			Interplanted Guineacorn		
	N ₁	N ₂	P ₁	N ₁	N ₂	P ₁
Paiye	... +111*	+107*	+93**	—77	—97	+22
Paiye	... +141**	+184**	+67	Crop Failure. Results not analysed		
Ballah	... +104*	+217***	—38	Crop Failure. Results not analysed		
Ballah	... +104*	+176***	+94**	—65	+16	+60
Okeoyi	... +38	+139*	—11	Crop Failure. Results not analysed		
Okeoyi	Yields below 200 lbs per acre			Crop Failure. Results not analysed		

TABLE 49.—GUINEACORN INTERPLANTED THROUGH EARLY MAIZE

Site			Guineacorn			Early Maize		
			N ₁	N ₂	P ₁	N ₁	N ₂	P ₁
Paiye	...	...	+3	—22	+143***	—41	—31	+29
Paiye	...	...	+94	+66	+190***	+2	+12	—26
Ballah	...	...	+298**	+538***	+84	+72	+92	+39
Ballah	...	...	+94*	+93*	+98**	+9	+88	+10
Okeoyi	...	...	Crop Failure. Results not analysed.			Crop Failure. Results not analysed.		
Okeoyi	...	...	Crop Failure. Results not analysed.			Crop Failure. Results not analysed.		

These results confirm the need of guineacorn at Paiye for phosphate and at Ballah for both types of fertiliser as indicated by the 1952 results.

From the Maize yields it would appear that this earlier planted crop also requires both types of fertilisers at all sites.

(2) *Time of Fertiliser Application.*—For the third year in succession of a trial designed to determine the optimum time of application of various rates of sulphate of ammonia to guineacorn was carried out at Ilorin, and an extract from the three years results is presented in Table 50.

TABLE 50.—TIME OF APPLICATION OF NITROGEN TO GUINEACORN ILORIN
(LB. GRAIN PER ACRE)

Experiment No.	L2(51)	L1(52)	LR1(52)53					
MAIN EFFECTS								
1. Sulphate of Ammonia	Not Sig.	Not Sig.	**					
Nil (N ₀)... ..	845	1,159	849					
60 lbs/acre (N ₁)	800	1,137	927					
120 lbs/acre (N ₂)	876	1,087	940					
2. Time of Application	Not Sig.	Not Sig.	Not Sig.					
At Planting (T ₁)	718	1,076	880					
At Flowering (T ₂)	978	1,151	924					
Split Application (T ₃)	814	1,156	911					
S.E. (lbs/acre) ...	±73	±27	±21					
5 per cent* Sig. Diff.	—	—	58					
1 per cent** Sig. Diff.	—	—	77					
Interaction	Not Sig.	***	Not Sig.					
1. T x N	N ₁	N ₂	N ₀	N ₁	N ₂	N ₀	N ₁	N ₂
At Planting (T ₁)	703	732	1,214	1,035	982	799	928	912
At Flowering (T ₂)	941	1,015	1,129	1,149	1,181	894	917	962
Split Application (T ₃)	752	876	1,139	1,231	1,102	852	936	944
5 per cent* Sig. Diff.	—	—	—	131	—	—	—	—
1 per cent** Sig. Diff.	—	—	—	173	—	—	—	—

Although the results are not significant, they do indicate that the later applications exert a more beneficial effect than applications made at planting time.

(3) *Trials on Farmers' own Farms.*—In order to ascertain the levels of nitrogenous and phosphatic fertilisers required to increase the yields of various crops under local farming conditions, a series of trials were carried out in Benue and Plateau Provinces during 1953 which were sited on farmers' own farms. Six farms were originally selected in each of eight areas in the two provinces, and on every site, the farmer followed his own particular system of cultivations, the only operations carried out by the Department being the fertiliser applications, and the recording of final yields. Each farm consisted of a single replication of a 3² factorial design, the treatments being three levels each of sulphate of ammonia and superphosphate, alone and in combination, to give a total of nine plots per farm.

In Plateau Province, guineacorn trials (Tables 52 and 53) were laid down at Andaha and Yelwa, while at Dengi groundnuts and cotton were used as the test crops. Significant results were obtained from all experiments with the exception of the groundnut trial at Dengi where due to poor site selection the number of replications had to be reduced to three. Final yield figures from this trial did however indicate a response to the single rate of application of superphosphate (50 lbs/acre) but not to the double rate. Sulphate of ammonia applications at both levels resulted in a depression of yield.

In the same area, cotton (Table 51) gave a significant response to both levels of the nitrogenous fertiliser, but did not respond to superphosphate applications.

TABLE 51.—FERTILISER TRIALS ON COTTON, FARMERS' PLOTS
DENG, PLATEAU PROVINCE (LB/AC. SEED COTTON)

	0	N1	N2	Mean for Phosphate
0 ...	186	226	302	238
P1 ...	197	356	326	293
P2 ...	169	217	290	225
Mean for Nitrogen**	184	266	306	252

Sig. Diffs. Main Effects: 1 per cent—88 lb/ac.;
5 per cent—65 lb/ac.

Fertiliser Dressings: 50 and 100 lb/ac. Superphosphate and Sulphate of Ammonia.

TABLE 52.—FERTILISER TRIALS ON GUINEACORN, FARMERS' PLOTS, ANDAHA, PLATEAU
PROVINCE (LB. PER ACRE GRAIN)

	O	N ₁	N ₂	Means for Phosphate
O	492	495	533	507
P ₁	668	822	719	736
P ₂	606	766	829	734
Means for Nitrogen**	589	694	694	659

<i>Sig. Diffs.</i>	<i>Main Effects</i>	<i>Interaction</i>
5 per cent	65	111
1 per cent	88	—
0.1 per cent	117	—

Fertiliser Dressings: Sulphate of Ammonia 40 and 80 lb/ac. Superphosphate 60 and 120 lb/ac.

<i>O</i>	<i>N</i> ₁	<i>N</i> ₂		<i>Means for Phosphate</i>
O 	472	511	532	505
P ₁	657	802	752	737
P ₂	701	690	712	701
Means for Nitrogen	610	668	665	648

Fertiliser Dressings: 50 and 100 lb/acre Superphosphate and Sulphate of Ammonia.

TABLE 54.—FERTILISER TRIALS ON GUINEACORN, FARMERS' PLOTS, OTURKPO, BENUE PROVINCE (LB. GRAIN PER ACRE)

	<i>O</i>	<i>N</i> ₁	<i>N</i> ₂	<i>Means for Phosphate</i>
O 	440	840	690	657
P ₁	550	745	820	705
P ₂	690	930	920	847
<i>Means for Nitrogen**</i>	560	838	810	736

Fertiliser Dressing: 56 and 112 lb/ac. Superphosphate and Sulphate of Ammonia.

At Oturkpo and Keffi however significant responses were obtained to the fertiliser applications, and these are summarised in Tables 54 and 55.

TABLE 55.—FERTILISER TRIALS ON GUINEACORN, FARMERS' PLOTS, KEFFI, BENUE PROVINCE (LB. GRAIN PER ACRE)

	O	N ₁	N ₂	Means for Phosphate**
O ...	620	953	893	822
P ₁ ...	660	1,060	1,313	1,011
P ₂ ...	1,120	1,293	1,227	1,213
Mean for Nitrogen*	800	1,102	1,144	1,015

Sig. Diff. *Main Effects:* 5% — 231 lb/ac.; 1% 320 lb/ac.

Fertiliser Dressings: 56 and 112 lb/ac. Superphosphate and Sulphate of Ammonia.

A series of trials on farmers' own farms was also carried out at Daudawa during 1953 to test the effects of various rates of nitrogenous and phosphatic fertilisers on cotton yields.

The same nine treatments as used in Benue and Plateau Provinces were tested, n₀, n₁ and n₂=0, 50, 100 lbs. sulphate of ammonia per acre.

p₀, p₁ and p₂=0, 50, 100 lbs. superphosphate per acre.

Final yield figures showed a significant response to the double dressing of sulphate of ammonia, but not to superphosphate, as shown in Table 56.

TABLE 56.—FERTILISER TRIALS ON COTTON, SETTLERS' FARMS, DAUDAWA, ZARIA PROVINCE (LBS/AC. OF SEED COTTON)

Rates of	Sulphate of Ammonia	Superphosphate
Nil	395	432
50 lbs/acre	446	426
100 lbs/acre	495	476

Differences required for significance at 5%* level=64 lbs/ac.

at 1%** level=86 lbs/ac.

S.E.=19.5% of G.M.

The fact that the 1953 results from Daudawa are in direct disagreement with those obtained in 1949 from experiments carried out on resettlement farms (significant and economic response to superphosphate) is being investigated.

As a whole the 1953 results from all farmers' own farm trials have been good and are being repeated on a larger scale in 1954 in all three provinces reported.

(4) *Neem Disorders*.—In co-operation with the Forestry Department an investigation was carried out during 1953 to ascertain the cause of a condition of yellowing in Neem seedlings (*Melia Azadirachta*) which had been reported from various nurseries in the Northern Region.

It was originally envisaged that a series of pot tests, using various nutrient solutions be carried out in order to ascertain if the observed yellowing was due to a lack of a trace element or elements, but during the course of preparation of these trials it was observed that while seedlings under shade were normal and healthy those with no shade were mildly affected with the chlorosis.

This aspect of the problem was investigated first, the effects of temperature and intensity of sunlight on the incidence of yellowing being ascertained by means of different coloured glass cages. The experiment ran for just over a calendar year during which time regular temperature and intensity of sunlight readings were taken, together with periodic observations on growth, vigour and incidence of chlorosis. Results from this trial showed that the observed yellowing was definitely associated with high light intensity, Table 57 illustrating this result.

TABLE 57.—CHLOROSIS IN NEEM SEEDLINGS—SUMMARY OF DATA

<i>Treatment</i>	<i>Mean light intensity (candles/sq ft)</i>		<i>Mean height of plants (cm)</i>	<i>Degree of Chlorosis</i>
A. Glass painted black...	...	Low 15.9	62.9	None
B. Glass painted green...	...	Low 20.0	68.2	None
C. Glass painted white...	...	Medium 37.9	54.1	Medium
D. Clear glass ...	...	High 1,600+	44.3	High

(5) *Soil Surveys*.—During 1953 the soil surveys carried out in the Northern Region have been primarily of a reconnaissance nature, and usually conducted in connection with particular schemes at the request of the Director of Agriculture. At Kudaru a survey of the proposed settlement scheme in the Tsetse cleared corridor was carried out and indicated that there was insufficient suitable soil for a large scale settlement scheme. Another reconnaissance survey carried out at Gadau in Bauchi province also showed insufficient suitable soil present, in this case the object being to ascertain if the area was suitable for a Groundnut Research Station or sub-station. At Bida a reconnaissance soil survey was carried out to ascertain if the tentative site of the Rice Research Station at Badeggi was representative of the soils in the fadama as a whole. The survey showed that the proposed experimental site was located solely on the light sandy soils of the fadama, and did not include any of the heavier clay soils which appeared to make up the greater percentage of the fadama. As a result a more detailed soil survey was undertaken by the Cocoa Soil Survey from Ibadan.

A detailed soil survey was carried out of the new Lowlands Experimental Farm located near the Shendam Development Area in Plateau Province. An interim report of this work has been prepared and shows that this farm of 2,000 acres is typical of the area, and contains the soils of the area in reasonable proportions. A full comprehensive report of the survey is to be prepared in the coming year.

Another detailed soil survey of a government farm—the Northern Research Station at Samaru has been started, and will be completed and reported in the coming year.

(6) *Miscellaneous: Citrus*.—The use of sulphate of ammonia and urea both as a soil dressing and as a spray to citrus is being investigated in co-operation with the Botany Section. This is a long termed project and no results are at present available.

Silage.—During 1953 an experiment was carried out at Daudawa on Sunflower designed to ascertain the optimum spacing and rate of application of Farm Yard Manure for silage making. The rates of Farm Yard Manure were used, 0-3 and 6 tons per acre, and the spacings employed were 12 inches; 18 inches; and 36 inches all on a 3-foot ridge. Random samples from all plots were taken immediately prior to harvest; and transported to Samaru for determination of Dry Matter, Crude Fibre, Crude Protein, Fat, Soluble Carbohydrate and P_2O_5 contents. To date results of the Dry Matter only are available, and these are recorded in the Agronomy Section report (page 9).

Irrigation Water.—During the latter part of 1953 an investigation was started at Sokoto which was designed to ascertain how much of the suspended material in the Rima and Sokoto rivers is deposited on the corresponding fadamas, and it is sufficient to maintain rice yields on the fadamas without fallowing.

As a preliminary, weekly samples of the water flowing in the two rivers were taken in order to ascertain the amount of suspended material contained in the flow, and the results of these analyses are presented in Table 58.

TABLE 58.—AMOUNT OF SEDIMENT AND pH OF WATER SAMPLES,
SOKOTO AND RIMA RIVERS

<i>Sample</i>					<i>Sokoto River</i>		<i>Rima River</i>	
<i>Date of Sampling</i>					<i>Wt. of Sediment (lbs.) per 1,000 gallons sample</i>	<i>pH</i>	<i>Wt. of Sediment (lbs) per 1,000 gallons sample</i>	<i>pH</i>
10/7/53	...	...	...	...	7	5.6	7	5.6
18/7/53	...	...	...	...	8	6.4	2	6.4
25/7/53	...	...	...	...	16	6.3	2	6.4
31/7/53	...	...	...	...	8	6.3	1	6.4
8/8/53	...	...	...	...	12	6.2	2	6.1
1/8/53	...	...	...	...	5	5.3	$\frac{1}{2}$	6.5
73/9/53	...	...	...	...	5	6.5	$\frac{1}{4}$	6.5
15/9/53	...	...	...	...	9	6.4	$\frac{1}{2}$	6.5
25/9/53	...	...	...	...	6	6.5	$\frac{1}{4}$	6.5
2/10/53	...	...	...	...	4	6.5	—	6.4

These results show a distinct difference in the amount of sediment carried by the two rivers, the Sokoto carrying an average of 8 lbs. of sediment per 1,000 gallons against the Rima's 1.6 lbs. i.e., five times as much.

A mechanical analysis carried out on the samples showed also a difference in the type of material carried, the material from the Sokoto river being much coarser and heavier, indicating a much faster rate of flow.

PART V.—COTTON BREEDING AND SELECTION

By H. E. King

INTRODUCTORY

The work has continued to consist predominantly of straight reselection and testing of material derived from Samaru 26C and its relatives. A number of introduced types have however been kept under observation as possible alternatives to 26C or as potential parents in a hybridization programme. Co-operation in trials of "Egyptian cotton" (*G. barbadense*) in Niger Province and elsewhere has been maintained.

A new departure this season has been a study of cotton seed disinfection for the control of the bacterial disease, *Xanthomonas malvacearum*. For this work Messrs. Plant Protection Limited posted Mr R. L. Burgess to work in Northern Nigeria for a season in association with the cotton breeding staff at Samaru and the field staff of the Department at Daudawa.

Co-operation by the cotton breeding staff in agronomic and fertiliser experiments and in the organisation of bulk seed multiplication and distribution was maintained.

Both in the yield testing of plant breeding selections and in all other work involving field trials progress has been hampered by difficult local conditions. These result in very wide yield variations, unpredictable fluctuations in pest and disease incidence and in general very high standard errors.

The liberal use of farm yard manure and chemical fertilisers as a means of reducing soil variability clashes with the need to test new strains under conditions not too far removed from those of the cultivators' crop. So also does the use of tractors in soil preparation to overcome labour shortage.

Large numbers of replications and the use of the most modern statistical designs has proved only a partial cure for the soil heterogeneity encountered.

The completion of the installation of an electrically driven saw gin and seed delinter at Samaru has proved a great help. Many hundreds of ginning percentage determinations have been made on samples which would have been quite beyond the capacity of the hand driven gin.

Extra storage space provided at Samaru this season has also helped in handling the produce of the outstation variety tests.

BREEDING, TESTING AND MULTIPLICATION

Replicated Progeny Row Test.—A test containing forty-eight progenies and a control type was planted in a balanced incomplete block design with eight replications. Yields were high and significant differences occurred between progenies in seed-cotton yield. In addition wide differences were found in ginning percentage and lint length as well as in such field characters as jassid resistance.

A number of very promising progenies have been picked out to go forward to larger scale trials.

Small Bulks Test.—This test also contained forty-nine treatments with eight replications. In this case "small bulks" (the next stage beyond progenies) were tested against 26C controls. The material under trial included a number of reselections from Samaru 26C and some from the related strains 26G, 26H and 26I. There were also a few other derivatives of Allen including some bred from "D5" from which Samaru 26C arose.

Differences between treatments were very highly significant and, taking into account ginning percentages and lint lengths, it was possible to choose with considerable confidence thirteen "strains" worthy of further testing. These included some 26I and D5 derivatives.

Six of the types in this test appeared twice, one using self-bred seed and one natural (open pollinated) seed. There appeared to be no difference in yielding power—no hybrid vigour was shown by plants from natural seed. The mean yields for the six types were as follows:—

Self-bred seed—896 lbs of S.C. per acre

Natural seed—882 lbs of S.C. per acre

Standard error—18.5 lbs of S.C. per acre

Strains Test.—Promising material brought forward from the previous season's small Bulks Test, together with strains already under trial and a number of "control" types, made up a set of forty-nine "treatments" for a third balanced incomplete block design with eight replications. Eight of these treatments were strains also included in the District Variety Tests (*see later*) while many of the others were relatives and rivals of these, excluded from the district tests in making the choice to fill the eight places available

The plot size for this experiment was approximately 1/200th acre (against approximately 1/400th for Small Bulks Test and 1/800th for the Replicated Progeny Row Test). A moderately low standard error was obtained and differences between treatments were very highly significant. The experiment was not however a satisfactory one as vegetative growth was too strong and damage by *Mirids* very heavy. In consequence botanical observations on the plants were vitiated and the yield differences cannot be taken to represent the relative merit of the strains under other (more normal) conditions.

It was possible however, taking into account the results of this test, the Small Bulks Test and the behaviour of some of the strains in previous seasons, to choose four new candidates for the coming season's District Variety Tests. Amongst these are two relatives of strain 479-25 (*see later*) of great promise and a derivative of 26I combining high seed-cotton yield with high ginning percentage.

The performance of the eight strains included here as well as in the District Variety Tests was, in general, in keeping with the results of the latter. The "New Issue" however did better in this test in comparison with "Nucleus Stock". Strain 49160-23 was disappointing; notably early, it was overtaken by other strains in late pickings. MU8 gave its usual performance, an increase of about 25 per cent over 26C in seed cotton yield with the advantage in terms of lint reduced to 17 per cent by reason of its low ginning percentage. This fruitfulness was manifested in spite of symptoms of bacterial blight (angular leaf spot and vein lesions) which singled it out as clearly more "susceptible" than 26C. It maintained its previous record of relative freedom from leaf tattering ascribed to *Mirids*.

Included in this test were two bulks both representing the "Select Progeny Bulk" made up from 10 progenies and tested last season. Seed was taken from a multiplication plot of this bulk and, in addition a new lot was prepared by mixing afresh seed of the ten components each from its own separate multiplication plot of 1952-53. The ten components also appeared in the test as separate treatments. The yields of seed-cotton per acre were:—

Once grown bulk	...	...	...	...	...	647.3 ± 27.4
Fresh bulking	...	...	...	...	...	646.8 ± 27.4
Mean of ten components	...	...	...	...	...	657.2 ± 8.7

There is no evidence here of any gain from mixing related material and allowing cross pollination in it for one season.

District Variety Tests.—The number of sites at which these tests were carried out was increased by one making nine and at three of them the experiments were duplicated to cover "Timely" and "Delayed" planting. Of the total of twelve experiments one was a complete failure (Maigana) through very bad growing conditions and one (the Delayed planting at Samaru) a failure statistically through very high soil heterogeneity.

The two experiments at Gombe could not be planted until August owing to the seed getting mislaid on the way.

The remainder were very successfully carried out (except for some mishaps with the picking) and gave useful, and on the whole consistent, results. The experiments in the present main producing areas, from Sokoto (represented by Gusau) to Gombe, all gave average yields falling within the range 420 to 650 lbs seed cotton per acre and reasonably comparable standard errors (*see* Table 59). These therefore have been taken together for presentation of combined results in Table 60.

TABLE 59.—DISTRICT VARIETY TESTS. SEASON 1953-54
SEED COTTON YIELDS FROM TEN EXPERIMENTS

Locality with yield of Control Type expressed in lbs. per acre in brackets	Yields of other Strains expressed as percentage of that of the Control Type. (26C commercial Stock ex-Stage F)							S.E.
	Nucleus Stock	New Issue	49160-23	479-25	479-27	49197 BCP	4721-65	
Samaru (422) ...	109	109	107	117	112	115	108	6.3
Daudawa (647) (Timely)	106	100	99	112	92	96	93	4.9
Daudawa (442) (Delayed)	104	103	98	117	94	108	94	7.1
Gusau (511) ...	102	105	104	107	111	102	104	4.2
Gombe (609) (Timely) ...	105	100	105	108	99	99	100	3.7
Gombe (407) (Delayed)	101	96	108	109	104	102	108	6.6
Kano (478) ...	102	101	94	101	92	114	109	5.2
Maiduguri (797) ...	104	106	107	94	100	112	114	5.1
Kontagora (128) ...	100	102	106	116	101	97	115	6.8
Zonkwa (214) ...	84	96	99	95	109	104	101	7.8

TABLE 60.—DISTRICT VARIETY TEST 1953-54
Data from Seven Experiments Combined
(See footnote (a))

<i>Strain</i>	<i>Seed-cotton Yield (b)</i>	<i>Gin Per cent (c)</i>	<i>Lint Yield (d)</i>	<i>Lint Length (e)</i>
Commercial Stock	505	34.2	173	35.1
(ex-Stage F)	(100)		(100)	
Nucleus Stock	526	34.9	184	35.8
(ex-Stage C)	(104)		(106)	
New Issue	515	34.6	178	36.0
(ex-Samaru)	(102)		(103)	
26C/49160-23	516	34.6	178	36.0
	(102)		(103)	
26C/479-25	556	33.3	185	36.2
	(110)		(107)	
26C/479-27	505	33.8	171	36.2
	(100)		(99)	
26C/49197 BCP.	527	34.9	184	35.7
	(104)		(106)	
26C/4721-65	514	35.7	184	35.1
	(102)		(106)	

(a) Samaru, Daudawa (2) Gusau, Gombe (2) and Kano.

(b) Seed-cotton yield given in lbs. per acre, averaged over the seven experiments, and (in brackets) as percentage of Commercial Stock.

(c) Average for the seven experiments.

(d) Pounds per acre and as per cent of commercial stock.

(e) Halo length on the combed seed in millimetres, average of seven experiments

The produce of all these tests was received at Samaru for ginning and sampling so that it is possible to quote ginning percentages, calculated lint yields and lint lengths in presenting the results. This has been done in Table 60.

It will be seen that these tests have provided confirmation that the nucleus stock of Samaru 26C (ex-Stage C) is a small advance on commercial stock in seed-cotton yield and has a higher ginning percentage and longer lint. It is the result of two seasons of multiplication at Daudawa of the issue made in 1951 of what was then described as "New Nucleus Stock". This was produced by bulking the seed of sixty-six chosen progenies of 26C derivation grown at Samaru in season 1950-51 from single plant selections made in 1949-50 season.

The commercial stock included for comparison is "Second Wave" seed which has undergone five seasons of multiplication since its issue by the Botanist in 1948 and was at "Stage F" of the multiplication scheme in 1952-53. The earlier issue—"First Wave" seed—was known to be deteriorated and was not included in these tests.

The stock described as "New Issue" has given slightly poorer average figures than "Nucleus Stock", chiefly due to poor results at Gombe, but has slightly longer lint.

Amongst the 26C substrains 479-25 stands out at Samaru, Daudawa and Kontagora and did well at Gusau and Gombe. This is the second season that it has given superior yields in these tests. It is of high lint quality, appreciably longer than 26 C and in spinning tests giving distinctly stronger yarns. A mass reselection expected to show an improved ginning percentage is being multiplied at Samaru in 1954-55.

As demonstrated last season 479-25 is also notably earlier in cropping than 26C. The delayed planting experiments were intended to test whether this character resulted in a greater increase in yield (relative to 26C) with a shorter growing season. Of this there was however no real indication this season, either with this strain or 49160-23, another early type.

This latter did poorly this year compared to last and is being replaced in future tests by a mass reselection.

The strain 4721-65, with high ginning per cent, is one of a series of promising selections some of which, now coming forward, are expected to prove better yielding and of greater lint length.

Of the experiments excluded from Table 60, (viz. the last three in Table 59) Maiduguri gave an unusually high average yield (for Nigeria). The order of merit of the strains was quite out of keeping with that shown elsewhere. Strain 479-25 was actually the lowest though the differences were not significant. This result is probably accidental as the same strain at Maiduguri last season did well. However conditions there are abnormal in that the low rainfall of the area seems to be supplemented on the experiment farm by abundant underground water.

In the Kontagora experiment yields were one again very low although in the district as a whole the cotton crop was much higher yielding this season. Strain 479-25 did very well (relative to others) as last season.

Zonkwa, with very low yields and high standard error, provided no real information on the relative merit of the strains.

Seed Multiplication Plots.—All the strains under test were included also in multiplication plots. Yields in these were generally good though not up to the level of the previous season. Owing to shortage of labour and working cattle the preparation of the land was delayed. Early rains caused excessive weed growth the removal of which prior to planting caused further delay and doubtless resulted also in the removal in quantity of plant nutrients. Fields manured early with farm yard manure grew a particularly heavy crop of weeds in June.

In addition to bulk seed production many of these plots were utilized for single plant reselection work. In several a very large number of plants were selected, described and picked for laboratory tests. From these after consideration of ginning percentages, lint lengths, seed weights and plant yields, bulks were made up in a manner similar to the "modal bulk" technique employed in Uganda.

The two most important of these were the plots of 479-25 and 49160-23 (*see* above under District Variety Tests). From the former, 1,157 plants originally selected in the field were reduced by reselection in the laboratory to 515 giving 49 lbs of seed. From the latter 782 selections were reduced to 193 to give 27 lbs of bulked seed.

Certain plants were kept from these and other strains for planting as progeny rows.

Seed Multiplication Scheme Gombe.—Sixty tons of seed of Samaru 26C from the Daudawa Multiplication Scheme were transported to Gombe and issued under close supervision to cultivators in the area served by the Pindiga cotton market.

The yields obtained were extremely high, the total weight of seed-cotton purchased at Pindiga market being about 760 tons. This represents over $12\frac{1}{2}$ tons S.C. per ton of seed issued. The nearest comparable figure, that for Stage E in S. Katsina was 10.9 and the average for the whole of Northern Nigeria about 5.2

The British Cotton Growing Association co-operated in this scheme by agreeing to become sole buyers at Pindiga. The Administration assisted by declaring the area a seed multiplication area in which restrictions could be imposed on the movement of seed-cotton.

Unfortunately the Pindiga cultivators, new to cotton growing for export, have no tradition of picking their seed-cotton clean enough to be passed as grade I. It was not on the whole probably any dirtier, as picked, than that in other regions but was presented for grading with little or none of the trash and diseased and stained cotton removed. In consequence it was graded about 50 per cent grade II and 50 per cent grade III.

In general, seed obtained by ginning grade III seed-cotton must be regarded as less suitable for planting than grades I and II. On average it can be shown to contain more pink bollworm larvae and give a lower percentage germination. It may also be more heavily infected with bacterial blight.

It is therefore customary to reject grade III seed when arranging seed distribution for planting. The present state of affairs in Gombe Division suggests that action is required to make it clearly profitable to the cultivator to pick over his produce as has been the general rule elsewhere. The alternative of accepting seed from grade III as fit for planting is an undesirable departure from a sound general rule.

The rejection of grade III seed from Stage C of the Daudawa scheme, in contrast, meant a loss of 1.8 per cent only of the total seed produced. This produce is picked over in store by paid labour without regard to economics.

STUDIES OF BACTERIAL BLIGHT AND SEED DISINFECTION

The status of bacterial blight (*Xanthomonas malvacearum*) as a factor affecting yields in Northern Nigeria is not yet well defined. The apparent position over the last seven seasons is summarised below:

1947-48 (Hutchinson and Pearson).

Disease present but, having regard to the standard of resistance of Samaru 26C, probably not very important.

1948-49 (Departmental Staff)

Recorded, with some strain differences observed but not noted as serious on 26C.

1949-50 (Cotton Breeder)

Symptoms (angular leaf spot and vein blight) considered to be sufficiently extensive and severe to reduce yield of 26C. Strain differences marked, many imported types more susceptible.

- 1950-51 Much less in evidence, late in appearing. Strain differences not easily seen. Attempt to produce infection by spraying with inoculum unsuccessful.
- 1951-52 Again symptoms late in appearing and never reaching serious proportions. Importance of the disease as affecting 26C very much in doubt.
- 1952-53 Much more obvious wide-spread and serious. Some 26C reselections of previous two seasons now found to lack adequate resistance.
- 1953-54 Again marked but possibly rather less so than in 1952-53. Clearly very variable indeed in its incidence from field to field.

Dr G. M. Wickens, Senior Plant Pathologist of the Empire Cotton Growing Corporation, Uganda, who visited Northern Nigeria in November 1953, expressed the opinion that the general level of leaf infection was such as to be capable of reducing yield considerably. In addition on some crops infection on sympodial branches was severe enough to cause appreciable direct loss of fruits.

It was further noted that damage was far more prevalent and severe where growth was poor as a result of poor soil, waterlogging and delayed weeding. Under better conditions the plants seemed able to tolerate a high degree of infestation by the pathogen and display strong stem resistance and some degree of leaf resistance.

The great variation in intensity of infestation and nature of symptoms makes it impossible to suggest any figure for the loss of yield which may be caused by this disease and also to design and carry out a trial to provide a sound figure for loss under natural conditions.

Evidence was however obtained from seed disinfection trials this season that a reduction in visible symptoms can, *in certain circumstances*, be followed by a marked increase in yield.

Mr R. L. Burgess of Messrs Plant Protection Limited laid down and supervised a number of replicated trials at Samaru and Daudawa using as seed dressings a number of chemical compounds known to reduce seed infection. In addition some larger observation areas were planted in co-operation with the Senior Agricultural Officer, Daudawa.

Briefly these trials showed that seed disinfection, particularly with organic mercuric compounds, could result in conspicuously less visible infection on seedlings and young plants and that this relative freedom from symptoms persisted for much of the season. The protection so afforded could be shown statistically to be associated with a quite marked yield increase in one experiment and an apparent relationship appeared also in certain of the observation areas.

In three other experiments obvious symptoms of disease failed to develop on the plants from untreated seed and no advantage whatever could be claimed for seed treatment.

It seems probable that the routine treatment of cotton seed for planting could have an appreciable effect on average but that its value will be dependent on season and local conditions. In any particular instance it may be that no improvement in yield can be demonstrated because conditions are unfavourable to the development of the disease or the untreated seed does not carry viable infection. The possibility of seed disinfection being rendered useless by infection coming in later from elsewhere has not yet been demonstrated in Northern Nigeria but must also be considered. Widespread use of disinfected seed over a number of years would perhaps reduce this danger.

On balance, the chances of seed disinfection proving economic seem good and continued trials are strongly indicated. The cost, with a battery of hand churns dressing a quantity of thirty-seven tons, has been calculated as barely one shilling per acre. This requires an additional yield of seed-cotton per acre of three pounds only to make the process profitable. There would however be some difficulty in organising the mass disinfection of 15,000 tons of seed annually.

It is hoped that disinfection of the seed used in the earlier stages of the multiplication scheme may have an effect persisting into the areas receiving the produce therefrom and eliminate the need for dusting the later stages.

AGRONOMIC EXPERIMENTS

(Reported here by arrangement with the Agronomist).

A series of planting date experiments with cotton have been carried out at Samaru and other parts in Northern Nigeria over a number of seasons. At some of these the additional factors of fertility level and spacing have been introduced to broaden the basis of inferences as to optimum planting date and to investigate possible methods of ameliorating the known bad effect of delayed planting. These experiments are still continuing and have already yielded more data than can be compressed into a report of this nature. The following remarks, together with Table 61, present what are thought to be the more immediately important features so far emerging.

The overall effect of varying the planting date over the range mid June to late August can be defined fairly clearly for average seasons and the main cotton growing areas. Between mid June and early July there is not, on average, a great deal to choose in terms of gross return per acre. June is sometimes substantially better and sometimes not. The variation can probably be accounted for by differences in June rainfall and the incidence of insect pests. With adequate soil moisture in mid June and in the absence of crippling attack by bollworm and stainer June planting would probably always be superior.

There are however four reasons for not advocating June planting. Firstly, without effective prohibition of August planting the result would be a further "spread" of planting dates with consequently more favourable conditions for insect pests within the growing season. Secondly it would reduce the length of the close season. Thirdly it would in some seasons result in the first bolls opening before the end of the rains with consequent loss of grade. Fourthly it would invite the accusation that the interests of the cotton crop were being promoted at the expense of food crops. In many seasons it would not be possible with present farming systems to get the food crop planting completed in time to turn to cotton planting extensively in Mid June.

TABLE 61.—COTTON PLANTING DATE EXPERIMENTS
COMPARATIVE SEED COTTON YIELDS FOR DIFFERENT PLANTING
TIMES OVER EIGHT SEASONS AT FOUR LOCALITIES

Locality Season and Manuring	Yield of Early July Planting in lbs S.C. per acre	Relative Yields at successive Plantings (Early July equals 100)			
		Mid to late June	Early July	Mid to late July	Mid to late August
SAMARU:					
1946-47	565	—	100	100	77
1947-48	735	—	100	76	48
1948-49	588	—	100	79	39
1950-51	505	106	100	73	—
1952-53 Manured ...	684	88	100	63	23
1952-53 Unmanured ...	412	107	100	55	18
1953-54 Manured ...	539	107	100	61	39
1953-54 Unmanured ...	238	157	100	109	59
DAUDAWA:					
1950-51	462	95	100	60	—
1952-53 Manured ...	417	163	100	86	57
1952-53 Unmanured ...	253	172	100	112	60
1953-54 Manured ...	507	94	100	84	50
1953-54 Unmanured ...	479	119	100	86	54
KONTAGORA:					
1946-47	154	—	100	82	73
1947-48	238	—	100	93	84
1948-49	194	—	100	50	24
1949-50	156	—	100	95	103
1953-54 Manured ...	104	76	100	80	48
1953-54 Unmanured ...	122	92	100	73	44
GOMBE:					
1953-54	361	113	100	77	49
Averages	—	114	100	80	51

The present policy is to tolerate planting in the second half of June where it is practised but to give the first week of July as the *recommended* date everywhere.

Beyond early July further delay in planting will almost always result in a marked drop. August planting will, on average, yield no more than half the return for the same seed issue and nearly the same labour.

This overall planting date effect is hardly influenced at all by level of soil fertility or a very wide range in plant population per unit area. Manuring and closer spacing are not even a partial antidote to August planting. There is however some indication that manuring may influence the comparison of mid June with July plantings. This is being followed up.

The overall effect of varying the spacing from 9 inches to 27 inches apart along 3 foot ridges (thinning to 2 plants per stand in each case) is very slight. On average 18 inches spacing (the standard) is about best. There is some indication of interaction of spacing and fertility level but this is more noticeable in plant size than fruiting. With early planting manure enables wide spaced plants to grow to very nearly three times the size of plants growing in one third of the space i.e. the amount of plant framework per acre is roughly the same at the two spacings. On poor unmanured soil or with late planting wide spaced plants do not cover the ground but they still show a higher yield per plant than close spaced plants.

PART VI.—COTTON ENTOMOLOGY

By M. A. Choyce

INTRODUCTION

Observations on the incidence of the major pests of cotton have continued at Samaru, Daudawa, Kontagora, Gusau, Gombe and Yola throughout the season.

Insecticide trials were held at Samaru, Daudawa and Kontagora, but no marked increases in yield were obtained in any of these experiments. Nevertheless, at Samaru information was obtained concerning the effects of control of mirids.

Observations on the emergence of adults of Red Bollworm from long-term pupae during 1952-53 have been completed.

Insect Pests: Diparopsis perditor.—Red Bollworm.—The heaviest attack of Red Bollworm occurred at Kontagora and Gombe; elsewhere the incidence was less and did not differ greatly from that recorded last year. Eggs were found throughout the season in most areas, and the maximum numbers of larvae were found during October and November.

Table 62 gives details of Red Bollworm activity during the season.

TABLE 62.—DIPAROPSIS PERDITOR. EGG AND LARVAL POPULATIONS 1953-54
(FIGURES FOR 1952-53 IN PARENTHESES)

Station	Eggs per plant	Egg count peak/acre	Larval peak per acre
Samaru (Botanist) ...	4.0 (4.8)	15,930 (18,290)	1,050 (1,480)
Samaru (Insecticide) ...	0.8 (1.5)	4,226 (3,570)	1,950 (1,970)
Daudawa (Insecticide) ...	2.8 (2.2)	4,472 (5,400)	3,170 (2,340)
Kontagora ...	12.9 (20.3)	17,500 (57,210)	6,180 (5,630)
Gusau ...	3.8 (3.5)	22,080 (7,260)	1,930 (2,830)
Yola ...	5.8 (6.0)	15,830 (15,240)	1,328 (4,180)
Gombe ...	3.4 (4.5)	6,130 (9,750)	11,110 (1,553)

The results of observations on the emergence of adults of Red Bollworm from long-term pupae during 1952-53 are given later in the report (page 85).

Platyedra gossypiella: Pink Bollworm.—Pink Bollworm were found in all areas, usually from late October onwards. At Samaru and Daudawa incidence was again low, and the largest populations were found at Yola and in Numan Division.

Table 63 shows the peak populations found in green and split bolls, together with the number of larvae per 1,000 split bolls from all pickings of the crop.

TABLE 63.—PLATYEDRA GOSSYPIELLA. LARVAL POPULATIONS, 1953-54
FIGURES FOR 1952-53 IN PARENTHESIS

			Peak population/acre in		No. of Larvae per 100 split bolls
			Green Bolls	Split Bolls	
Samaru (Botanist)	...		270 (830)	50 (303)	4 (20)
Samaru Insecticide)	...		850 (1,440)	670 (61)	11 (11)
Daudawa (Insecticide)	...		Nil (810)	Nil (120)	Nil (5)
Kontagora	...	...	5,520 (1,110)	850 (120)	26 (5)
Gusau	...	...	2,250 (710)	510 (760)	23 (24)
Yola	...	...	3,900 (11,680)	1,510 (3,000)	52 (119)
Gombe	...	...	4,750 (7,990)	390 (4,610)	20 (168)
Numan Division:					
1. Shellen	...	...	13,190	—	89
2. Shellen	...	...	4,740	—	46
3. Guyuk	...	...	2,440	—	113
4. Bobbini	...	...	2,880	—	77
5. Gukuri	...	...	13,470	—	41

Other Bollworms:

Earias spp. (Spiny and Egyptian Bollworms) were reported from all areas, with between 2,000 and 3,000 per acre occurring in green bolls during late October and November. The attack was heaviest at Gombe, where nearly 10,000 per acre was recorded in December. Additional damage to growing points was caused by these bollworms early in the season.

Argyroplote leucotreta (False Codling Moth) and *Heliothis armigera* (American Bollworm) were uncommon in all areas.

Dysdercus supersticiosus—Cotton Stainer.

Stainers moved into the crop during September and generally remained in the crop until harvest. At Gombe and Kontagora over 10,000 per acre were recorded during October. Elsewhere peak populations of 2,000-3,000 per acre occurred, except in Numan Division, where numbers were generally higher.

At Samaru few stainers were found after an early migration into the crop, and it is possible that breeding occurred before suitable food (split bolls) was available for the nymphs.

Mirids and Leaf Tattering.—Mirids were again common at Samaru. On the Insecticide Trial the population of *Campylomma* was much less than last year. Migration into the crop reached a peak of only 1,600 swept per acre during early October. *Lygus*, though present in far fewer numbers than *Campylomma*, was more common than last year.

Tattering was again extremely variable. On the Main Farm at Samaru it was moderate, while parts of the Extension fields suffered considerably. At Daudawa tattering was common, particularly at Shemi where in spite of excellent growth, some patches failed to set bolls early in the season. In other areas tattering was generally slight.

However, yield figures indicate that the cotton was able to compensate to a large extent for the early damage by further growth and fruiting. This is confirmed by the results of the Samaru Insecticide Trial.

Miscellaneous Pests.—The usual minor pests of cotton were noted.

CROP LOSS

Shedding.—Maximum loss from shedding occurred during October and November. Results of an examination of shed buds and bolls, and split bolls are given in Table 64.

TABLE 64.—PERCENTAGE DAMAGE BY BOLLWORMS AMONGST SHED BUDS, SHED AND ABORTED BOLLS AND RIPE BOLLS, 1953-54. (FIGURES FOR 1952-53 IN PARENTHESIS)

Station			Shed Buds	Shed and Aborted Bolls	Ripe Bolls
Samaru (Botanist)	...	...	43.5 (30.2)	39.5 (32.2)	56.5 (25.3)
Samaru (Insecticide)	...	...	26.6 (50.4)	15.2 (34.9)	27.0 (35.7)
Daudawa (Insecticide)	...	...	41.8 (44.9)	26.1 (20.7)	30.4 (38.3)
Kontagora	...	...	39.7 (59.2)	45.6 (63.9)	68.9 (92.3)
Gusau	...	...	57.5 (46.3)	42.2 (31.5)	37.5 (38.3)
Yola	...	...	56.5 (52.2)	17.0 (30.3)	37.4 (70.9)
Gombe	...	...	41.5 (39.1)	36.6 (29.6)	56.1 (47.9)

Heavy shedding occurred at Kontagora (35,000 buds and bolls per acre per week on 14th November, at Gombe (27,000 per acre per week on 31st October) and at Yola (25,000 per acre per week on 17th October).

Although bollworms were responsible for a high proportion of sheds in some areas, many fruiting points were lost because of stainers early in the season. At Samaru and Daudawa many fruiting points were lost owing to the feeding of mirids.

Nevertheless, even in the absence of these insect pests, shedding by the cotton plant can be high, as illustrated by the results obtained on the Insecticide Trial at Samaru this year. On the control plots shedding of bolls reached a figure of over 50,000 per acre per week early in November, and only about 10 per cent of these were damaged by Bollworms.

The relationship between flower production, shedding and the formation of ripe bolls is illustrated in Figure 1. This is based on the examination of the fate of 915 flowers tagged on the control plots of the Insecticide Trial during the season. The

results suggest that the shedding was caused by an overproduction of fruiting points during the favourable period of growth, and the inability of the plant to mature these fruiting points during the remainder of the season. The yield of these plots was nearly 700 lbs. seed cotton per acre.

Damage to Ripe Bolls.—An analysis of damage to split bolls is given in Table 65. The lowest proportion of clean seed cotton was produced at Yola, where losses due to causes other than bollworms were high. The results from Gombe, and from peasant farms in Numan Division, also show a low percentage of clean cotton.

TABLE 65.—PERCENTAGE OF LOCK-DAMAGE IN NON-SHEDDING BOLLS. 1953-54
(FIGURES FOR 1952-53 IN PARENTHESIS)

Station	Undamaged	Damaged			
		Bollworm		Non-bollworm	
		Partial	Total	Partial	Total
Samaru (Botanits) ...	53.6 (75.8)	11.0	10.6	15.5	93
Samaru (Insecticide) ...	76.5 (68.4)	4.6	5.1	11.7	2.2
Daudawa (Insecticide) ...	76.2 (60.3)	11.9	8.4	1.8	1.8
Kontagora Standard ...	46.9 (18.1)	18.3	6.5	14.0	14.3
Gusau Standard ...	56.3 (61.2)	6.2	4.0	27.9	5.6
Gusau Peasants 1 ...	62.0 (63.0)	7.0	7.1	18.0	5.9
Gusau Peasants 2 ...	60.8 (—)	6.6	9.5	11.9	11.2
Yola Standard ...	24.0 (28.0)	5.7	8.7	38.8	23.0
Gombe Standard ...	41.4 (57.9)	20.0	5.7	23.3	9.6
Numan Division:					
Shellen 1 ...	27.6	17.7	28.1	17.1	9.5
Shellen 2 ...	39.2	13.3	24.0	14.0	9.5
Guyuk ...	33.8	14.7	19.6	20.0	11.9
Gukuri ...	59.5	10.0	12.5	13.1	4.9

INSECTICIDE TRIALS

(a) *Daudawa.*—The main trial at Daudawa was designed to compare the effect on yield and pest incidence of insecticide applied to cotton as a dust, as a low volume spray, and as a high volume spray.

The treatments were as follows:—

A: 4 lb. of D.D.T. per acre applied as a cotton dust containing 10 per cent D.D.T., and 3 per cent gamma BHC.

B: 4 lb. of D.D.T. per acre applied as high volume spray at rate of 48 gallons per acre.

C: 4 lb. of D.D.T. per acre applied as low volume spray at rate of 16 gallons per acre.

D: Control.

There were six replications of each treatment on plots of $\frac{1}{4}$ acre, with adequate discards, and applications of all treatments were made on 22nd October, 12th November and 3rd December, 1953. The trial was situated on Daudawa Main Farm.

Yields are given in Table 66, and do not show any significant differences between treatments.

TABLE 66.—DAUDAWA INSECTICIDE TRIAL 1953-54: YIELDS IN LBS. SEED COTTON PER ACRE

Treatment A.	Dust	...	...	...	...	357
Treatment B.	High Volume Spray	...	...	...	...	399
Treatment C.	Low Volume Spray	...	...	...	...	385
Treatment D.	Control	...	...	...	...	371

Cotton dust containing 10 per cent D.D.T. and 3 per cent gamma BHC. was also applied to an area of 2 acres of cotton showing excellent growth near the main insecticide trial. 30 lb. of dust per acre were applied on 22nd October and 12th November, a third application being impossible owing to a steady harmattan. The yield of this area was 390 lbs. seed cotton per acre, compared with 415 lbs. per acre from an untreated area of similar growth adjacent to the dusted cotton.

The records of pest incidence on the main trial have not yet been examined in detail, but they show that insect damage was generally low. The yields obtained, however, indicate that insect pests were not a limiting factor in seed cotton production, at least in the area of the trial, and in these circumstances, the application of insecticides was entirely uneconomic.

(b) *Kontagora*.—A small insecticide trial was held at Kontagora where dust containing 5 per cent D.D.T., 3 per cent gamma BHC. and 40 per cent sulphur was applied to cotton at rate of 30 lbs. per acre. Applications were made on 14th November, 21st November, 28th November and 2nd December.

The treatment plots yielded 215 lbs. seed cotton per acre compared with 202 lb. from untreated plots.

The experiment was carried out on a local farm on cotton planted after fallow on 15th August.

As at Daudawa, pest incidence was low and the cotton obtained from the area of the trial was all Grade I. The result cannot therefore be regarded as representative of what would have occurred elsewhere in Kontagora, where insect damage was much higher.

(c) *Samaru*.—Information concerning this experiment is given below, although the analysis of the results has not yet been completed and final conclusions made. Provisional indications are that a moderate mirid attack does not reduce the final yield of the crop, but merely delays its maturation. The cotton plant is able to compensate for early loss of fruiting points by further growth and fruiting.

Samaru Insecticide Trial, 1953-54 (Expt. S8(53))

This experiment was arranged to distinguish between the effects of mirid and boll-worm attack on the development and yield of cotton. It is a repetition on a larger scale of a similar experiment carried out during 1952-53, the results of which were inconclusive owing mainly to a wide variation in fertility within the experimental area.

The experiment was laid down on the Main Farm within an area of 4 acres of reasonably uniform cotton sown on 17th July and manured with 3 tons per acre F.Y.M.

Eight replications of four treatments were arranged into two 4 x 4 Latin Squares, the treatments being:—

A—Early spraying to control Mirids. 0.3 per cent D.D.T. at rate of 30 gallons per acre (0.9 lbs. D.D.T. per acre) applied six times at weekly intervals on 8th, 15th, 22nd, 29th September, 6th and 13th October.

B—Late spraying to control Bollworms. 1.14 per cent D.D.T. at rate of 35 gallons per acre (4.0 lb. D.D.T. per acre) applied 4 times at 2-week intervals on 27th October, 10th November, 24th November and 10th December.

C—Early and Late spraying as for treatments A and B to control mirids and Bollworms.

D—Untreated control.

Each plot consisted of 27 ridges of 18 yards (approximately equal to one-tenth acre) and detailed observations were taken throughout the season on insect incidence and damage, and on crop development. Nine rows in each plot (162 square yards) were preserved for yield estimation only, to prevent errors due to handling.

Results: 1. Mirid Population.—The method of obtaining an estimate of the Mirid population reported in the Annual Report for 1952-53 was again used. This consisted of sweeping 9 yards of ridge three times for each observation, the total number of mirids caught being used to estimate the swept population per acre. Observations were made on the day before and the day after each application of the Early Spray, a different 9 yards of ridge being used on each occasion.

The results do not show the true mirid population per acre owing to the difficulty of catching these small and active insects in the net. Neither are they strictly comparable with the results obtained last year since different observers were used. Nevertheless they can be used to compare the populations within one experiment.

Campylomma was again the most common mirid present, but the swept population per acre was much lower than that recorded during the 1952-53 experiment. *Lygus*, on the other hand, though present in far fewer numbers than *Campylomma*, was definitely more common than last year. Small numbers of *Lygus* are known to do considerable damage to cotton, so that the damage produced by each is not necessarily in the same proportion as their respective populations.

Figures 3 and 4 show the variation in the swept population of *Campylomma* and *Lygus* respectively during September and October. Treatments A and C which received early spraying are compared with treatments B and D which received no insecticide during this period.

The peak population of *Campylomma* (1,600 swept per acre) occurred during the first week of October compared with a peak of 20,000 swept per acre on 7th October, 1952. The peak population of *Lygus* is not so clearly indicated owing to the small numbers involved, but probably occurred during early September.

Figure 3 shows the degree of control of *Campylomma*, the mean population during the period of early spraying on treatments A + C being reduced to 27 per cent of that on the untreated plots. The true control achieved is obscured by the fact that the application of insecticide to treatments A + C also effected the population of the untreated plots. During the interval between applications the rate of migration into treated and untreated plots was similar, until the maximum population was attained.

The interference between treated and untreated plots is seen more clearly in Figure 4, which shows that insecticide application to half the plots of the experiment depressed the *Lygus* population to a similar extent over the whole of the experiment.

2. *Mirid Damage*.—A more precise method of determining mirid damage was used this year giving results less liable to subjective errors, and also showing the variation in damage that occurs throughout the season. 10 plants in each plot were examined at weekly intervals, the top 4 fully expanded leaves on the main stem being scored from 0 to 4 as determined by comparison with a photographic scale of damage. The maximum score per plant was 16, indicating very severe damage, and the lowest score was 0, indicating no damage.

Table 67 shows the total scores per treatment for seven weeks, with the scores for A and C expressed as a percentage of B and D.

TABLE 67.—SAMARU INSECTICIDE TRIAL, 1953-54. SCORES FOR MIRID DAMAGE

Date	Treatments				A + C as percentage of B + D
	A	B	C	D	
22nd September ...	404	538	425	583	74
29th September ...	326	535	308	516	60
6th October ...	278	430	224	506	54
13th October ...	167	382	163	407	42
20th October ...	134	335	129	396	36
27th October ...	118	376	121	330	34
3rd November ...	122	354	109	311	35
Totals ...	1,549	2,950	1,479	3,049	50

Note.—Numbers represent total score on a scale of 0-4 on top four fully opened leaves of main stem of 80 plants per treatment per week.

The data for Figure 5 has been obtained for each treatment by determining the number of plants with scores for damage within the groups 0-1, 2-3, etc., to 14-15. This shows the variation in damage shown by plants within the same treatment.

Mirid damage as recorded by this method showed a maximum when recordings began, decreasing as the season advanced on treated and untreated plots. The decrease in tattering on the untreated plots was much less than that recorded for the sprayed plots.

The variation in damage is not comparable directly with the mirid population at the time, because tattering is a result of feeding by the insects at the leaf bud stage, and about a month elapses before the leaf is fully expanded. In addition the rate

of growth of the plant during the period of mirid attack, and hence the availability of flower and leaf buds for food, is probably different to the rate of increase in the mirid population. The results suggest that the food available per insect increased during September and October so that tattering became progressively less in spite of the higher insect population.

3. *Bollworm Populations*.—The most common bollworms attacking the crop were the Red and Spiny Bollworms (*Diparopsis perditor* and *Earias* spp.). On the control plots two peaks of egg-laying by the Red Bollworm occurred, the first of 2,300 per acre during the second week of October, the second of 4,200 per acre during the second week of November. Larval peaks of nearly 2,000/acre occurring during the weeks following maximum egg-laying. No Red Bollworms were found in the crop after early December.

The *Diparopsis* and *Earias* Indices show no marked differences between treatments presumably owing to the markedly low level of infestation, but the figures indicate that *Earias* was at least as damaging as *Diparopsis*.

Only small numbers of larvae of the False Codling Moth (*Argyroplote leucotreta*), Pink Bollworm (*Platyedra gossypiella*) and American Bollworm (*Heliothis armigera*) were recorded.

TABLE 68.—SAMARU INSECTICIDE TRIAL, 1953-54. PERCENTAGE DAMAGE BY BOLLWORMS TO SHED BUDS, SHED BOLLS ABORTED BOLLS AND RIPE BOLLS

Treatment		A	B	C	D
Shed buds ...	...	24.8	30.3	23.1	26.6
Shed bolls ...	...	12.5	14.5	12.2	15.0
Aborted bolls ...	...	27.8	25.1	18.1	24.9
Ripe Bolls ...	...	26.4	22.4	18.8	27.0

4. *Bollworm Damage*.—Table 68 shows the percentage of shed buds, shed bolls, aborted bolls, and ripe bolls damaged by bollworms. An analysis of lock damage in ripe bolls is given for each treatment in Table 69.

TABLE 69.—SAMARU INSECTICIDE TRIAL, 1953-54. PERCENTAGE LOCK DAMAGE IN RIPE BOLLS

Treatment				A	B	C	D
Clean locks ...	...	...	...	76.1	80.8	81.3	76.5
BW Partial Loss ...	...	...	...	4.6	3.8	3.5	4.6
BW Total Loss ...	...	...	...	5.3	3.5	3.6	5.1
Non-BW Partial Loss ...	...	...	...	12.9	9.6	10.2	11.7
Non-BW Total Loss ...	...	...	...	1.1	2.3	1.3	2.2

5. *Crop Development*.—Flower counts were taken daily on all plots, and show that during the period of early spraying, more flowers were produced on sprayed plots than on the unsprayed plots.

Treatments A + C produced 173,000 flowers per acre during the period from 13th September to 24th October, compared with a total of 150,000 on treatments B + D.

The subsequent fate of the flowers on the Control plots is shown in Figure 1, but a more detailed analysis of the results has yet to be made to determine whether differences between treatments can be demonstrated.

6. *Yields*.—Table 70 gives the total yields for each treatment, there being no significant difference between them.

TABLE 70.—SAMARU INSECTICIDE TRIAL, 1953-54. YIELDS IN LBS. SEED COTTON PER AC.

<i>Treatment</i>			<i>Yield</i>	<i>Percentage of Control</i>
A	...	...	695	100
B	...	...	785	113
C	...	...	763	110
D	...	...	694	100
			S.E.	39
			Coeff. of Variation	14.9%

Five pickings were made, on 7th, 15th, and 22nd of December, and on 4th and 26th of January. The percentage of the total yield taken at each picking is shown in Table 71.

Early spraying resulted in an earlier maturation of the crop, whereas late spraying has given a more even yield at each picking. The timing of the crop subjected to early and late spraying was similar to that of the untreated crop.

TABLE 71.—SAMARU INSECTICIDE TRIAL, 1953-54. PERCENTAGE OF TOTAL YIELD TAKEN AT EACH PICKING

				<i>Treatment</i>			
<i>Date of Harvest</i>				<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
7th December	...	...	...	41.2	26.8	34.5	33.5
15th December	...	...	...	29.4	25.5	27.9	27.2
22nd December	...	...	...	17.3	23.4	20.6	19.9
4th January	...	...	...	10.3	21.5	15.2	16.7
26th January	...	...	...	1.8	2.7	1.8	2.8

7. *Conclusions*: (Provisional).—Because of the low level of bollworm attack no significant increases in yield due to control of bollworms was achieved in this experiment.

Control of mirids, with a subsequent reduction in visible leaf damage is possible by means of series of spray treatments during September and early October.

Adequate control can be achieved by weekly applications of 1 lb. of D.D.T. per acre during the build-up of mirid population.

Owing to the continued migration of mirids into cotton during this period, frequent applications of insecticide are necessary, but these could be reduced if a more persistent insecticide was used.

Under the conditions of this experiment control of mirids did not result in any increase in yield, but caused the crop to mature earlier. When subjected to a moderate

mirid attack the cotton plant, which in any case normally produces more bolls than it can mature, is able to compensate for early loss of fruiting points by further growth and fruiting.

EMERGENCE OF RED BOLLWORM FROM LONG TERM PUPAE 1952-53

In experiments conducted at Samaru during 1948 and 1949 Geering (1) showed that the emergence of moths from long-term pupae of *Diparopsis perditor* was bimodal, the first period extending from early June to early July, and the second during October. A similar bimodal emergence was recorded during 1950. The following year Baillie and Geering (2) showed that a unimodal emergence occurred from long-term pupae kept in the laboratory under equable temperature conditions and in the absence of water-logging.

Similar experiments showing the emergence of moths from long term pupae during 1953 have now been completed and confirm the main points of the earlier work.

During the period October to December 1952 just over one thousand "rattlers" were set in pupation troughs under conditions simulating these found in the field. "Rattlers" were also set at weekly intervals in the laboratory during November and December 1952. One series (A) was kept in an incubator at 90°F, and a second series (C) was kept in a humidity chamber. A series (B) of pupae without the earthen cell was also placed in the incubator.

Humidity in the incubator and humidity chamber was maintained at a high and fairly constant level by means of a saturated solution of sodium chloride. Heating of the incubator was discontinued from the end of April, 1953, as external temperatures over 90°F made the attainment of a constant temperature impracticable. Temperature and humidity readings were taken daily except on public holidays and Sundays, and monthly means are given in Table 73. Meteorological data in the area of the pupation troughs is given in Table 72.

(1) Emp. Cott. Grow. Corp., Reps. Expt. Stns. 1949-50.

(2) Emp. Cott. Grow. Corp., Reps. Expt. Stns. 1950-51.

TABLE 72.—DIPAROPSIS EMERGENCE: 1952-53. METEOROLOGICAL DATA, SAMARU

Month	Soil Temperature		Air Temperature °F			Rainfall	Relative Humidity 1928-52
	08.00	14.00	Mean Min.	Mean Max.	Mean	Inches	
1952							
October ...	73	93	97	88	77	1.82	63.5
November ...	71	98	61	89	75	—	35.5
December ...	66	95	58	87	73	—	24.5
1953							
January ...	65	100	58	91	74	—	23.6
February ...	73	103	62	95	78	0.33	21.0
March ...	78	103	68	97	83	—	25.6
April ...	78	108	70	97	83	—	36.7
May ...	76	92	71	98	85	10.07	62.8
June ...	74	88	69	87	78	5.97	71.7
July ...	73	84	68	83	75	11.56	77.9
August ...	72	83	68	82	75	8.74	81.5
September ...	72	88	67	91	79	8.92	76.2
October ...	74	96	65	90	77	0.30	63.5
November ...	67	97	59	89	74	—	35.5
December ...	61	91	55	85	70	—	24.5

Notes.—(a) Soil temperatures were taken in pupation troughs at depth of 1½ inches.

(b) Air temperatures determined from readings in Stevenson Screen.

(c) Monthly mean Relative Humidity has been determined from 08.00 and 14.00 readings taken during the years 1928-1952 in Stevenson Screen.

TABLE 73.—DIPAROPSIS EMERGENCE' 1952-53. LABORATORY TEMPERATURES AND HUMIDITIES

Month	HUMIDITY CHAMBER				INCUBATOR			
	Air Temp.		Rel. Hum.		Air Temp.		Rel. Hum.	
	Mean Max.	Mean Min.	08.00	14.00	Mean Max.	Mean Min.	08.00	14.00
1952								
November	87	71	81	71	90	80	83	82
December	83	71	80	71	88	80	83	81
1953								
January	85	76	81	71	88	82	82	81
February	87	78	85	74	87	84	82	81
March	90	83	86	76	92	88	85	83
April	94	84	86	73	95	90	85	83
May	89	82	89	81	88	83	89	87
June	89	79	90	83	86	80	89	88
July	85	77	90	86	82	78	90	90
August	83	76	90	87	81	76	90	92
September	84	76	88	83	81	77	90	91
October	86	79	90	83	84	80	91	89
November	86	76	87	79	83	77	87	84
December	79	71	85	79	85	79	86	84

Note.—(a) Relative humidity determined from "Edny" paper hygrometers.
(b) Readings taken daily except on Sundays and Public Holidays.
(c) Heating of incubator discontinued from end of April.

Records of the emergence of moths in the pupation troughs and in the laboratory were recorded throughout 1953. Table 74 shows that about one-quarter of the moths set in the troughs produced moths. The reason why so many moths failed to emerge is obscure; infection by Dipterous parasites probably killed about one-fifth of the rattlers (*see* below). Nearly half of the rattlers set in the laboratory produced moths, and a high proportion are still apparently healthy and may yet produce moths. (Table 75).

TABLE 74.—DIPAROPSIS EMERGENCE 1952-53: TROUGH SETTINGS

Week Set	Week Ending (1952)	No. Set	Short Term Emergence	Failed to Emerge	Reset 19-6-53	Long Term Emergence	Failed to Emerge
10	October 11	11	4	7	0	0	0
11	October 18	37	13	24	0	0	0
12	October 25	147	74	73	3	3	0
13	November 1	135	43	92	23	6	17
14	November 8	207	14	193	124	33	91
15	November 15	145	4	141	114	24	90
16	November 22	95	0	95	72	3	69
17	November 29	23	0	23	18	4	14
18	December 6	30	0	30	19	5	14
19	December 13	83	0	83	43	7	36
20	December 20	79	0	79	40	11	29
21	December 27	59	0	59	23	7	16
22	January 3	19	0	19	8	2	6
		1,070	152	918	487	105	382

TABLE 75.—DIPAROPSIS EMERGENCE, 1952-53—LABORATORY SETTINGS

Date (1952) full-grown larvae collected	Date Rattlers Set	Series No.	No. Set	Moths Emerged	Parasites Emerged	Dead	Missing	To Emerge	Series No.	No. Set	Moths Emerged	Parasites Emerged	Dead	Missing	To Emerge	Total
30/10-1/11	11/11/52	A1	17	12	0	1	0	4	B1	33	20	1	3	0	9	C1
8/11-10/11	19/11/52	A2	7	4	1	0	0	2	B2	5	2	0	5	1	0	C2
13/11-15/11	27/11/52	A3	21	12	5	0	0	4	B3	21	10	6	5	0	0	C3
20/11-22/11	4/12/52	A4	6	4	0	0	0	2	B4	2	2	0	0	0	0	C4
4/12-6/12	11/12/52	A5	18	10	5	1	0	2	B5	17	6	2	0	6	1	C5
11/12-13/12	18/12/52	A6	15	4	3	1	0	4	B6	13	9	3	1	0	0	C6
11/12-13/12	24/12/52	A7	12	4	3	2	0	5	B7	27	5	1	4	4	0	C7
18/12-20/12	2/1/53	A8	8	2	3	2	0	1	B8	14	2	2	3	0	0	C8
12-27/12	8/1/53	A9	4	2	2	0	0	0	B9	9	4	4	1	0	0	C9
		Total	108	54	23	7	0	24	Total	121	60	19	21	11	10	Total

The incidence of parasitism by a Dipteran, (*Carcelia* sp.), determined from the laboratory observations, is 18.5 per cent, or 23.4 per cent if rattlers yet to emerge are excluded. This is twice as large as that reported by Baillie and Geering (2), and indicates that this is not a negligible factor in the control of the Red Bollworm under natural conditions.

The development of diapause during October and November is shown in Table 76 together with the figures for 1950. The figures are based on living material only and shown that by the third week in November all pupae were long term.

The times of emergence from long-term pupae during 1953 in the troughs and in the laboratory are shown in Figure 2, in which the number of moths emerging during the two-week intervals has been plotted as a percentage of the total emergence.

In the troughs the emergence was bi-modal with a pronounced peak during the second week of October. In contrast to emergencies recorded in 1949-50, however, there was only a break of about two weeks between the early and late emergence. The duration of this break is evidently very variable, and it would seem reasonable to suppose that in some seasons it is non-existent, emergence being continuous from June to October. If this is true, the behaviour of *D. perditor* in Northern Nigeria resembles more closely the activity of *D. castanea* in Nyasaland, where the emergence from diapause pupae extends from December to May, with a distinct drop in the wettest month, January.

Emergence of moths in the laboratory from the incubator and humidity chamber was continuous (Series A and Series C in Figure 2), though rather earlier than from the troughs, and confirms results obtained by Baillie and Geering.

The emergence from pupae which had been removed from their earthen cells was distinctly earlier than that from rattlers maintained under similar conditions (Figure 2, Series B). If a similar result was achieved under field conditions it would reinforce the view that early cultivation of land after growing cotton reduces the incidence of Red Bollworm during the next season. Geering (unpublished paper) has suggested that restriction of aeration during July and September delays emergence of the moth. Removal of the pupal cells may have a reverse effect by increasing aeration, so that early cultivation, in so far as it breaks up the earthen cells, would induce emergence when no cotton was growing.

TABLE 76.—DEVELOPMENT OF DIAPAUSE IN *D. PERDITOR*, SAMARU

<i>Period of Collection of full grown larvae 1952</i>	<i>Percentage of long-term pupae</i>	<i>Period of Collection of full grown larvae 1950</i>	<i>Percentage of long-term pupae</i>
Oct. 5 to Oct. 11	...	Oct. 2 to Oct. 8	0
Oct. 12 to Oct. 18	...	Oct. 9 to Oct. 15	5.5
Oct. 19 to Oct. 15	...	Oct. 16 to Oct. 22	9.7
Oct. 25 to Nov. 1	...	Oct. 23 to Oct. 29	37.8
Nov. 2 to Nov. 8	...	Oct. 30 to Nov. 5	65.5
Nov. 9 to Nov. 15	...	Nov. 6 to Nov. 12	78.5
Nov. 16 to Nov. 22	...	Nov. 13 to Nov. 19	100.0

Based on living material only. Figures for 1950 taken from Empire Cotton Growing Corporation, Rep. Expt, Stns. 1949-50.

PART VII.—PASTURE RESEARCH SECTION

By A. Blair Rains

The work of this section has continued on a very modest scale but with some interesting results and with some success.

In an attempt to find what equipment is required to thresh and clean grass seed a quantity of grass in head was sent in bales to the National Institute of Agricultural Engineering in the United Kingdom. With the equipment at their disposal they were able to decide on the most suitable machines for the purpose and did in fact produce extremely good, and certainly drillable samples of the four grasses sent which were *Andropogon gayanus*, *Hyparrhenia rufa*, *Pennisetum pedicellatum* and *P. polystachyon*. It is hoped to follow up this work and to establish seed preparation on a practical basis.

Another most stimulating feature has been the behaviour of introduced material from several different parts of the world. While some varieties, as is inevitable, have proved impossible to establish, others have shown much promise, although this must not be taken to mean that the indigenous species are being neglected. Lucerne (*Medicago sativa* and *M. media*) varieties from America have been established and have produced viable seed. Inoculation was essential and a light dressing of superphosphate produced a marked increase in growth. Other promising legumes include *Alysicarpus glumaceus*, *Stylosanthes gracilis* strains, *S. sundaica*, *Phaseolus lathyroides* and several *Indigofera* species. It is, however, too early at this stage to decide what place, if any, they might fill in agricultural practice. Introduced Grasses which have shown considerable promise have included strains of *Chloris gayana*, *Cenchrus ciliaris* and *Brachiaria brizantha*.

Experiments have included a trial of *Pennisetum pedicellatum* strains, a comparison of annual grasses; and experiments with four grasses to determine optimum spacing. Another to investigate crude protein in four grasses subject to different cutting treatment, with and without sulphate of ammonia, has been started.

Results of the *Pennisetum pedicellatum* (Kyasuwa) strain are given in Tables 77 and 78 which show yields in dry weight and crude protein per acre.

TABLE 77—KYASUWA STRAINS TRIAL—ONCE AND TWICE CUT
(LB. DRY WEIGHT PER ACRE)

Strain No.	Cut once: 18 weeks after planting	Cut twice: 11 and 18 weeks after planting
1	10,990	4,380
10	9,700	4,210
21	10,620	4,460

In analysing the results for the dry weight there is no difference between the strains but significant difference between plots cut once and those cut twice. The results for crude protein do not show any significant difference between the once cut and the twice cut; but the twice cut with the higher percentage protein would be the more valuable fodder,

TABLE 78—KYASUWA STRAINS TRIAL—ONCE AND TWICE CUT
Lbs. crude protein per Acre

Strain No.	Cut once	Cut twice
1	233.3	209.8
10	277.1	263.6
21	240.7	252.9

The experiment involving annual grasses is also incomplete but the results obtained are given in Table 79. The grasses employed were *Pennisetum pedicellatum* Strain 10, *Rottboellia exaltata* and a fodder Sorghum; *Chloris gayana* was introduced to compare the behaviour of a perennial grass.

Cutting treatments were: one cut, eleven weeks after planting (and the aftermath cut ten weeks later); and two cuts, one seven weeks after planting the second ten weeks later; it must be mentioned that it was not originally planned to cut any aftermath.

TABLE 79—COMPARISON OF CUTTING TREATMENTS—FOUR SPECIES OF GRASS. (EQUIVALENT LB. DRY MATTER PER ACRE)

Weeks after planting	11	21		7	17	
Species	Cut	Aftermath	Total	1st Cut	2nd Cut	Total
<i>Pennisetum pedicellatum</i>	4,670	3,180	7,850	270	8,080	8,350
<i>Rottboellia exaltata</i> ...	7,060	1,390	8,450	2,110	3,880	5,990
<i>Sorghum</i> sp. ...	5,997	1,358	7,355	1,828	3,952	5,780
<i>Chloris gayana</i> ...	3,156	3,154	6,310	390	4,790	5,180

Although there is a significant difference ($P=0.05$) between treatments, the more interesting information is in the figures themselves. The two massive grasses, Sorghum and *Rottboellia* produced more bulk in one cutting than in two; they did not recover quickly after cutting. The *Chloris* and *Pennisetum* were slower starting (small seed) but were more flexible, and the productivity of the *Chloris*, a perennial, was interesting.

Root samples were taken from the plots and these figures are also given (Table 80).

TABLE 80 COMPARISON OF CUTTING TREATMENTS—ROOT WEIGHTS
(LB. DRY MATTER PER ACRE)

Species	Cut and Aftermath	Two cuts
<i>Pennisetum pedicellatum</i> ...	304	245
<i>Rottboellia exaltata</i> ...	126	208
<i>Sorghum</i> ...	274	172
<i>Chloris gayana</i> ...	244	275

It should be mentioned that the *Chloris* and *Pennisetum* both produce a finer root system than the other grasses,

The Spacing experiment includes four grasses *Cenchrus ciliaris*, *Chloris gayana*, *Pennisetum polystachyon* and *Andropogon gayanus*, sown as spaced plants, in rows, and in a sward. Two of the grasses are of the large tussock type (*Pennisetum* and *Andropogon*) and the other two are low growing in habit.

The Experiment was sown at beginning of June, 1953 and is now in its second year. Tabulated Results up to the present time are set out in Tables 81 and 82.

TABLE 81—SPACING EXPERIMENT WITH FOUR SPECIES OF GRASS
(LB. PER ACRE DRY MATTER)

			<i>Cenchrus ciliaris</i>	<i>Chloris gayana</i>	<i>Pennisetum polystachyon</i>	<i>Andropogon gayanus</i>
<i>First cut, August 1953</i>						
Spaced	...	...	451	869	700	1,239
Rows	...	...	1,399	1,799	2,022	2,570
Sward	...	...	1,354	2,085	1,395	1,770
<i>Second cut, Dry Season 1953-54</i>						
Spaced	...	...	1,719	3,253	2,325	2,251
Rows	...	...	1,838	2,498	1,896	2,062
Sward	...	...	484	1,840	753	2,049
<i>Third cut, (second harvest year) June 1954</i>						
Spaced	...	...	1,063	1,246	1,321	1,634
Rows	...	...	1,087	1,101	1,242	1,809
Sward	...	...	692	1,379	729	1,977
<i>Total to date (three cuts)</i>						
Spaced	...	...	3,233	5,368	4,346	5,124
Rows	...	...	4,324	5,398	5,160	6,441
Sward	...	...	2,530	5,304	2,877	5,796
Mean	...	...	3,362	5,357	4,128	5,787

TABLE 82—SPACING EXPERIMENT, SOLUBLE CARBOHYDRATE AND CRUDE
PROTEIN (SOL. CARBOHYDRATE AND C.P. IN LB. PER ACRE)

			<i>Cenchrus ciliaris</i>		<i>Chloris gayana</i>		<i>Pennisetum polystachyon</i>		<i>Andropogon gayanus</i>	
			<i>S. carb</i>	<i>C.P.</i>	<i>S. carb</i>	<i>C.P.</i>	<i>S. carb</i>	<i>C.P.</i>	<i>S. carb</i>	<i>C.P.</i>
<i>First Cut</i>										
Spaced	...	...	131	57	308	142	255	103	490	147
Rows	...	...	501	109	767	132	846	111	1,078	166
Sward	...	...	562	84	958	91	626	61	832	111
Mean	...	...	396	83	678	122	576	92	733	141

While it is true that the results are generally following an overall pattern there are exceptions and at this half way stage to make observations would probably be a mistake.

An observation trial on plant succession subsequent to mowing, grazing, burning and combinations of these treatments at different times of the year has been started at the Stock Farm, Shika. It is intended to assess the changes in botanical composition, including the amount of regeneration of scrub plants which were initially cleared, both during the course of the trial as well as at its conclusion. The productivity of the pastures under each type of treatment is also being studied. It is hoped to commence similar trials at other centres.

An investigation into the germination of seeds of *Cynodon dactylon* has been undertaken, but with inconclusive results. Seeds were collected monthly and sown at two week intervals. Overall germination was .25 per cent; the best germination was found among seed collected at the end of the wet season and in the first month of the dry season. It is not possible to state if there is a dormancy period. It has been suggested that diurnal variations in temperature before sowing increase germination but this cannot be confirmed. As an arable weed *Cynodon dactylon* probably spreads vegetatively, with occasional new plants from seed and from the point of view of control it appears that vegetative parts only need be considered. As a pasture grass germination is too poor to enable it to be effectively established from seed and it suffers seriously from competition after vegetative propagation.

An attempt is being made to study the development of *Andropogon gayanus* particularly the deposition of lignin in the leaf.

APPENDIX I

SENIOR SERVICE STAFF IN THE DEPARTMENT: 1953-54

<i>Name</i>	<i>Rank</i>	<i>Qualification</i>
HEAD QUARTERS STAFF		
J. D. Brown	Director of Agriculture until 14-2-54	B.Sc. (Agric.) Aberdeen
P. C. Chambers	Director of Agriculture from 14-2-54 onwards	B.A. (Agric.) Cantab. Dip. Agric. Cantab. A.I.C.T.A.
M. W. Gibbon	Deputy Director of Agriculture	Sch. Mod. B.A. (Mat. Sci.) Trinity Coll; Dublin. Passed in prescribed subjects. (Agric. Cambridge. A.I.C.T.A. (Trinidad)
E. W. Momber	Assistant Director of Agriculture	B.Sc. (Agric) Dip. Agric. (Cantab) A.I.C.T.A.
J. M. S. Usher-Wilon	Principal Agricultural Officer	B.S.A. (Toronto). A.I.C.T.A.
S. A. Dawuda	Accountant	—
S. A. Priddy O.B.E.	Administrative Assistant Grade II	—
E. Nwora Emodi	Administrative Assistant Grade II	—
Miss A. M. E. P. Leedam	Secretary-Typist	—
FIELD STAFF		
T. N. Greeves	Senior Agricultural Officer	B.Sc., M.A. (Agric)
A. H. S. Vigo	Senior Agricultural Officer	—
T. E. Ryall	Senior Agricultural Officer	B.Sc., A.I.C.T.A.
L. D. C. Cromwell	Agricultural Officer	London Matriculation
A. G. Cullum	Agricultural Officer	B.SC. (Wales) with honours in Agric.
J. A. Carter	Agricultural Officer	Dip. Agric.
A. A. Kingshotte	Agricultural Officer	B.Sc. (Agric.) Reading D.T.A. (Trinidad)
D. M. Grieve... ..	Agricultural Officer	B.Sc. (Agric.)
P. Mulholland	Agricultural Officer	Dip. Agric.
R. B. Shorter	Agricultural Officer	—
G. G. Goodale	Agricultural Officer	B.Sc. (Agric.)
S. Z. Moczarski	Agricultural Officer	M.A. (Cantab). (Cert. of proficiency in Agric.)
G. C. Speers	Agricultural Officer	B.Sc. (Agric.)
R. L. Waddell	Agricultural Officer	B.Sc. (Agric.)Dip. Agric. (Cantab)
D. J. Mckinlay	Agricultural Officer	B.Sc. (Agric.)
Mallam Lawan	Agricultural Officer	—
L. Lotringer	Agricultural Superintendent	B.Sc. (Agric.)
R. A. Hind	Agricultural Superintendent	B.Sc. (Agric.)
J. M. Garba	Agricultural Superintendent	B.Sc. Econ. (London)
J. Ricketts	Agricultural Superintendent	N.D.A., S.D.A., N.D.D.H. S.D.D.H.
M. Shehu Gombe	Agricultural Superintendent	—
F. C. A. Okpaise	Agricultural Superintendent	Yaba Dip. in Agric. Trinidad Refresher Course
R. D. Bowers	Agricultural Superintendent	B.Sc. Agric. (Nottingham)
J. L. Cooper	Agricultural Superintendent	—

D. J. Iddon	Agricultural Superintendent	Dip. Hort (Nottingham)
F. A. Tyler	Agricultural Development Officer	" —
F. Bennett Lloyd	Agricultural Development Officer	Dip. in Agric.
R. G. Brereton	Agricultural Development Officer	—
G. P. Hewes	Agricultural Development Officer	Agric. Cert.
E. O. Hobson	Agricultural Development Officer	—

MINES RECLAMATION STAFF

A. J. Evans	Mines Land Reclamation Officer	—
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RESEARCH STAFF

J. H. Gisborne	Principal Agricultural Officer	B.A. (Oxon) A.I.C.T.A.
E. J. Butler	Senior Agricultural Officer	B.A. (T.C.D.) 1st Class Honours in N. Science (Botany, Zoology and Geology)
A. R. Maurer	Specialist Officer	B.S.A. (M.B.C.) N. Science (Mc. Gill.)
G. M. Higgins	Specialist Officer	B.Sc. (Hons.) Wales, Dip. Agric. Science (Cantab)
A. B. Rains	Specialist Officer	B.Sc. (Hons) St. Dip. Agric. Sci. (Cantab)
Miss E. Harrison	Specialist Officer	B.Sc. (Hons.) St. And. Dip. Agric. Sci. (Cantab), D.T.A. (Trinidad)
D. R. Williams	Specialist Officer	B.Sc. Agric. (N. Wales), B.Sc (Honours)
H. Irving	Chemist	Agric. Chemist B.Sc. (Agric.)
W. R. Wilson	Lab. Superintendent	—

OFFICERS OF THE E.C.G.C.

H. E. King	E.C.G.C. Cotton Breeder	B.Sc. (Agric.) Dip. in Agric.
D. A. Lawes	E.C.G.C. Cotton Breeder	B.Sc. (Agric.) Univ. of Wales, Honours in Agric. Botany
M. A. Choyce	E.C.G.C. Entomologist	B.Sc. Hons. (Zoo.)
A. M. Kryzwon	E.C.G.C. Cotton-Mult. Officer	M.A. (Cantab) Agric.

ENGINEERING STAFF

A. B. Emmerich	Principal Agric. Engineer	B.Sc. Agric. Engineering M.A. S.A.E.
W. Matthewson	Agricultural Engineer	Associate Member of Inst. of Br. Agric. Engineers (A.M.I.B.A.E)
W. Ferguson	Agricultural Engineer	B.Sc. M.Sc. Agric. Engineering (G.I.Mech.E.)
J. E. S. Palmer	Agricultural Engineer	B.A. (Agric.) Cantab., M.Sc. Agric. Engineering
N. Slater	Mechanic Demonstrator	—
R. V. W. Watts.	Mechanic Demonstrator	Admiralty Workshop Certificate
E. Davies	Mechanic Demonstrator	—
R. G. Gilbert	Mechanic Demonstrator	—
H. J. W. Smyth	Mechanic Demonstrator	—
R. C. Bish	Mechanic Demonstrator	—
F. Weldin	Mechanic Demonstrator	O.N.C. Mech. Engineering
J. Isaac	Mechanic Demonstrator	London City and Guilds Certi- ficate
M. G. Green	Mechanic Demonstrator	—

IRRIGATION STAFF

J. Kitching	... Principal Irrigation Engineer	B.Sc. A.M.I.C.E.
A. A. Symyth, O.B.E.	... Irrigation Engineer	B.Sc. Civil Engineering (Belfast)
H. M. Epton	... Irrigation Engineer	A.M. Inst. C.E. Spl. A and B.
E. Mulligan	... Irrigation Engineer	B.E. B.Sc. A.R. and Sc. I., M.I.C.G.I.
F. S. E. England	... Irrigation Engineer	B.Sc. Civil Engineering (Bristol)
D. St. E. Michell	... Irrigation Engineer	B.Sc. (Civil Engineering), Natal Engineer-University of Liege, (Belgium)
I. J. Lhoneux	... Irrigation Engineer	B.Sc. (Civil Engineering, Cape Town University)

SCHOOL STAFF

T. A. Phillips	... Principal, School of Agriculture	B.Sc. Hortic. (Reading) A.I.C.T.A.
A. E. L. Thorpe	... Agricultural Superintendent	-
K. A. Watson	... Agricultural Superintendent	B.Sc. Agric. (Syd.)
W. C. Evely	... Agricultural Superintendent	Dip. Agric. (Seale Hayne)

PRODUCTION DIVISION

F. G. Nelson... ..	... Production Officer	—
R. T. A. Woodhouse	... Production Officer	—
R. Hitchcock	... Production Officer	—
W. Price	... Production Officer	—
N. Hopes	... Production Officer	—
I. J. Jones	... Production Officer	—
N. Mcleod	... Production Officer	—
D. P. Drew	... Production Officer	B.Sc. (Agric.) London
A. H. T. Trevor	... Production Officer	—
Lt. Col. A. H. Wagstaff	... Production Officer	—
D. E. Summers	... Production Officer	—
P. D. Mansfield	... Production Officer	R.H.S. Cert. in Hort.
T. Blair	... Production Officer	—
A. F. A. Chapman	... Production Officer	Cert. in Agric.
J. F. H. Oates	... Production Officer	N.D.A., C. D. A., (H.A.A.C.)
P. B. Harris	... Production Officer	B.Sc. (Agric.)
C. W. Morgan	... Production Officer	B.Sc. (Hons.) B.Sc. Agric (Wales)
J. R. Phillips	... Production Officer	N.D.A., C.D.A., (H.A.A.C.)
J. G. Simpson	... Production Officer	N.D.A., S.D.D.H., S.D A (W.S.A.C.)
P. W. J. Whitehead	... Production Officer	Dip. Agric.
K. G. Windsor	... Production Officer	B.Sc. (Agric.)
G. I. Roberts	... Production Officer	B.Sc. Agric. (Glasgow)
N. L. Palmer	... Production Officer	Dip. Farm Inst. (Glam.)
H. S. Clayton	... Production Officer	—
J. T. Downes	... Production Officer	Farm Inst. Cert.
E. P. Tredinnick	... Production Officer	B.A. (Agric.) Cantab
G. E. Wickens	... Production Officer	B.Sc. (Botany and Agriculture)
P. Stonard	... Production Officer	B.Sc. Agric. (London)
P. N. Gosden	... Production Officer	B.Sc. (Agric.)

N. Thompson	...	... Production Officer	B.Sc. (Agric.)
F. N. Godwin	...	... Production Officer	B.Sc. (Agric.)
A. Ross	...	... Production Officer	N.D.A., N.D.D.I., S.D.D.H. and S.D.A. (Dairying) (W.S.A.C.)
C. P. Woodiwis	...	... Production Officer	N.D.A., N.D. Ag. E., C.D.A., C.D. Ag. E., (M.I.B.A.E.)
J. Henson	...	... Production Officer	—
R. B. Woodroffe	...	... Production Officer	N.D.A., C.D.A. (Leeds)
R.T. Harberd	...	... Production Officer	B.Sc. (Agric.)

APPENDIX II

MARKET PRICES---GUINEA CORN : 1953-54

'Mudu' or Bag Prices converted to Price per Ton

Province and Market	April 1953		May 1953		June 1953		July 1953		August 1953		September 1953		October 1953		November 1953		December 1953		January 1954		February 1954		March 1954	
	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d
Adamawa (Yola)	15	0 0	15	0 5	18	0 0	23	0 0	23	0 0	23	0 0	23	0 0	23	0 0	18	0 0	18	0 0	18	0 0	23	0 0
Bauchi (Bauchi)	14	0 0	14	14	13	17 10	16	4 4	16	9 0	14	5 0	14	7 0	14	8 0	14	18 10	14	18 0	14	8 0	23	8 0
Benue (Yandev)	16	3 0	13	0 0	14	0 0	16	11 8	20	17 6	21	6 0	14	18 4	16	0 0	14	10 0	11	6 0	14	0 0	16	11 0
Borno (Maiduguri)	13	1 4	12	10 0	12	10 0	12	10 0	11	4 0	11	4 0	11	4 0	14	0 0	16	0 0	19	0 0	18	10 0	23	13 0
Borno (Horn)	23	0 0	28	0 0	33	0 0	22	6 8	28	0 0	28	0 0	32	0 0	—	—	23	0 0	22	8 0	22	8 0	22	8 0
Kabba (Idah)	15	0 0	20	0 0	14	0 0	22	0 0	18	0 0	18	0 0	18	0 0	14	18	—	—	22	0 0	22	0 0	28	0 0
Kabba (Okene)	14	0 0	7	9 4	8	8 0	18	13 4	7	0 0	18	13 4	29	12 4	14	18	14	0 0	12	8 8	18	13 4	18	13 4
Kano (Local)	17	10 0	17	0 0	16	0 0	17	0 0	17	0 0	21	0 0	23	0 0	22	0 0	25	0 0	26	0 0	29	0 0	32	0 0
Katsina (Daudawa)	13	2 0	13	0 0	13	0 0	15	5 0	10	5 0	11	5 0	11	5 0	16	0 0	16	0 0	17	18 0	20	0 0	17	10 0
Katsina (North)	13	2 0	11	5 0	13	0 0	9	8 0	10	5 0	11	5 0	16	17 6	22	10 0	22	8 0	22	8 0	28	0 0	31	15 0
Katsina (Daura)	14	18 4	11	3 4	11	3 4	11	3 4	14	16 0	11	3 4	14	15 2	22	8 0	22	8 0	28	0 0	28	0 0	31	15 0
Niger (Kontogara)	11	1 4	11	1 4	11	1 4	14	15 2	14	15 2	14	15 2	14	15 2	14	18 0	11	1 0	11	1 0	11	1 0	14	19 0
Niger (Bida)	17	0 0	17	0 0	17	0 0	15	0 0	19	10 0	22	10 0	22	10 0	19	0 0	15	0 0	20	0 0	22	10 0	26	0 0
Plateau (Riyom)	17	10 0	17	10 0	17	0 0	21	0 0	22	0 0	22	0 0	22	0 0	20	0 0	19	0 0	21	0 0	21	0 0	26	10 0
Sokoto (Gusau)	17	0 0	22	0 0	14	0 0	18	0 0	23	0 0	17	0 0	28	0 0	28	0 0	23	0 0	30	0 0	29	0 0	32	0 0
Sokoto (West)	14	0 0	14	0 0	14	0 0	18	0 0	14	0 0	18	0 0	18	0 0	24	0 0	22	0 0	22	0 0	24	0 0	43	0 0
Zaria (Zaria)	14	10 0	19	0 0	17	0 0	17	0 0	16	0 0	16	0 0	15	0 0	15	0 0	15	0 0	23	0 0	23	0 0	23	15 0

MARKET PRICES MILLET : 1953-54

'Mudu' or Bag Prices converted to Price per Ton

Province and Market	April 1953		May 1953		June 1953		July 1953		August 1953		September 1953		October 1953		November 1953		December 1953		January 1954		February 1954		March 1954	
	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d	£	s d
Adamawa	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bauchi (Bauchi)	—	—	17	4	7	14	8	17	4	7	16	16	0	13	11	6	14	7	0	14	18	8	—	—
Benue (Yandev)	10	13	0	16	10	0	11	10	0	14	0	0	14	0	0	16	11	8	29	16	0	30	0	0
Bornu (Maiduguri)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19	0	0	22	0	23	10	0	0
Ilorin (Ilorin)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kabba (Kene)	9	0	0	10	0	16	0	22	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kabba (Idah)	22	10	0	18	0	0	19	0	0	14	0	0	14	0	0	22	0	0	22	0	39	0	0	0
Kano (Local)	15	0	0	15	0	0	15	0	0	18	10	0	22	10	0	25	0	0	27	0	33	0	0	0
Katsina (Daudawa)	16	17	0	13	6	15	0	15	0	15	0	0	15	0	0	18	0	0	30	0	33	15	0	—
Katsina (North)	16	17	0	13	6	15	0	15	0	15	0	0	15	0	0	18	0	0	30	0	33	15	0	—
Katsina (South)	16	16	8	14	18	4	14	18	4	11	3	4	14	8	4	22	8	4	28	0	31	15	0	—
Katsina (Daura)	11	19	4	11	19	4	11	19	4	12	0	0	11	13	0	11	19	0	11	18	0	12	3	0
Niger (Kontogara)	17	0	0	17	0	0	19	0	0	19	0	0	20	10	0	15	0	15	0	15	0	22	10	0
Niger (Bida)	15	0	0	17	0	0	19	0	0	12	0	0	18	0	0	17	0	17	0	27	0	27	0	0
Plateau (Riyom)	17	0	0	17	0	0	19	0	0	20	0	0	21	0	0	23	0	23	0	38	0	38	0	0
Sokoto (Gusau)	24	0	0	14	0	0	18	0	0	18	0	0	21	0	0	24	0	28	0	46	0	46	0	0
Sokoto (West)	16	0	0	14	0	0	18	0	0	28	0	0	18	0	0	23	0	37	0	37	0	37	0	0
Zaria (Zaria)	17	0	0	20	0	18	0	16	0	16	0	0	16	0	0	19	0	19	0	26	0	28	0	0

MARKET PRICES—RICE : 1953-54

‘Mudu’ or Bag Prices converted to Price per Ton

Province—Market	April 1953	May 1953	June 1953	July 1953	August 1953	September 1953	October 1953	November 1953	December 1953	January 1954	February 1954	March 1954
Adamawa (Yola) ..	—	—	—	—	—	—	—	—	—	—	—	—
Bauchi (Bauchi) ..	—	—	—	—	—	—	—	—	—	—	—	—
Benue (Yandev) ..	—	—	—	—	—	—	—	—	—	—	—	—
Bornu (Maiduguri) ..	—	—	—	—	—	—	—	—	—	—	—	—
Ilorin (Ilorin) ..	—	59 0 0	62 0 0	—	—	—	—	—	—	—	—	—
Kabba (Idah) ..	52 0 0	0 8	67 0 0	67 0 0	70 0 0	74 0 0	56 0 0	59 0 0	56 0 0	56 0 0	74 13 4	59 0 0
Kabba (Okene) ..	65 6 0	65 6 8	65 6 8	53 6 8	0 0	112 0 0	112 0 0	56 0 0	56 0 0	56 0 0	74 13 4	74 13 4
Kano (Local) ..	55 0 0	55 0 0	55 0 0	62 0 0	67 0 0	56 0 0	58 0 0	65 0 0	60 0 0	65 0 0	70 0 0	70 0 0
Katsina (Daudawa) ..	65 0 0	67 0 0	67 0 0	67 0 0	67 0 0	67 0 0	67 0 0	—	—	—	—	—
Katsina (North) ..	—	—	—	—	—	—	—	—	—	—	—	—
Katsina (Daura) ..	—	—	—	—	—	—	—	—	—	—	—	—
Niger (Kontagora) ..	45 0 0	49 0 0	51 0 0	53 0 0	54 0 0	67 0 0	60 0 0	41 0 0	41 0 0	45 0 0	48 15 0	52 0 0
Niger (Bida) ..	56 0 0	56 0 0	65 0 0	65 0 0	65 0 0	65 0 0	67 0 0	60 0 0	56 0 0	45 0 0	45 0 0	45 0 0
Plateau (Riyom) ..	42 0 0	33 0 0	36 0 0	56 0 0	46 0 0	46 0 0	47 0 0	62 0 0	47 0 0	63 0 0	68 0 0	58 0 0
Sokoto (Guasu) ..	37 0 0	41 0 0	40 0 0	41 0 0	56 0 0	45 0 0	56 0 0	44 0 0	45 0 0	60 0 0	67 0 0	70 0 0
Sokoto (West) ..	—	—	—	—	—	—	—	—	—	—	—	—
Zaria (Zaria) ..	—	—	—	29 0 0	23 0 0	43 0 0	56 0 0	—	—	—	—	—

MARKET PRICES—YAMS : 1953-54

‘Mudu’ or Bag Prices converted to Price per Ton

Province	April 1953	May 1953	June 1953	July 1953	August 1953	September 1953	October 1953	November 1953	December 1953	January 1954	February 1954	March 1954
Benue (Yandev) ..	—	14 18 4	16 1 8	21 13 0	14 10 0	8 4 0	8 0 0	9 7 0	9 10 0	9 0 0	14 13 0	12 11 0
Ilorin (Ilorin) ..	28 0 0	28 0 0	46 0 0	28 0 0	18 13 0	9 6 8	18 13 4	—	19 0 0	14 0 0	—	21 0 0
Kabba (Idah) ..	12 0 0	28 0 0	14 0 0	12 0 0	12 0 0	9 0 0	9 0 0	11 0 0	12 0 0	14 0 0	15 0 0	18 0 0
Kabba (Okene) ..	10 2 0	14 0 0	9 6 8	11 13 4	9 6 8	9 6 8	9 6 8	9 6 8	14 0 0	14 18 8	24 5 4	17 14 8

MARKET PRICES—MAIZE

‘MUDU’ OR BAG PRICES CONVERTED TO PRICE PER TON

Province—Market	April 1953	May 1953	June 1953	July 1953	August 1953	September 1953	October 1953	November 1953	December 1953	January 1954	February 1954	March 1954
ILORIN (Ilorin) ..	£ s d 37 0 0	£ s d 41 0 0	£ s d 42 0 0	£ s d 28 0 0	£ s d 28 0 0	£ s d 32 13 4	£ s d 37 6 8	£ s d —	£ s d 28 0 0	£ s d 33 12 0	£ s d 33 12 0	£ s d 33 12 0
Kabba (Idah) ..	16 0 0	20 0 0	18 0 0	11 0 0	22 0 0	14 0 0	22 0 0	9 0 0	15 0 0	22 0 0	26 0 0	26 0 0
Kabba (Okene) ..	18 13 4	18 13 4	18 13 4	18 13 4	18 13 4	18 13 4	22 8 0	18 13 4	18 13 4	18 13 4	22 8 0	28 0 0
Pateau (Riyom) ..	14 0 0	16 0 0	20 0 0	20 0 0	16 10 0	16 10 0	20 0 0	15 0 0	16 0 0	18 0 0	18 0 0	30 0 0

APPENDIX III

MONTHLY RAINFALL—1953

Province	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total For Year (Inches)	Average Yearly Rainfall
Adamawa (Jimeta)	—	—	—	—	9.09	6.05	3.99	3.83	9.10	1.95	—	—	34.01	39.21 (36 years)
Bauchi (Bauchi)	—	0.30	—	1.01	8.06	4.62	11.36	8.39	7.11	0.62	—	—	41.47	43.30 (27 years)
Benue (Yandev)	0.13	1.26	2.48	1.28	8.50	5.02	11.61	2.47	7.47	4.33	0.14	—	44.39	53.94 (26 years)
Bornu (Maiduguri)	—	—	—	—	2.18	3.99	12.91	7.56	4.53	—	—	—	31.17	25.11 (36 years)
Borno (Florin)	—	0.85	4.28	2.54	10.60	10.35	8.91	1.39	10.00	8.03	—	0.13	57.08	49.70 (48 years)
Kabba (Okene)	0.08	4.34	5.75	0.36	5.88	8.03	6.51	10.34	9.20	2.81	—	—	49.09	49.31 (16 years)
Kano (Kano)	—	—	—	—	5.22	6.51	6.53	10.34	3.47	0.02	0.93	—	32.09	33.36 (26 years)
Katsina (Katsinoli)	—	—	—	—	6.40	5.02	9.87	4.67	2.81	0.52	—	—	29.29	31.08 (21 years)
Niger (Bida)	—	0.70	0.39	0.29	6.50	5.87	12.77	6.09	7.74	2.10	—	—	42.45	47.20 (17 years)
Plateau (Riyom)	—	1.48	2.07	1.64	4.82	6.87	9.65	13.58	8.10	0.70	—	—	48.91	57.50 (11 years)
Sokoto (West)	—	—	—	—	7.22	3.78	6.60	4.86	5.11	0.92	—	—	28.49	28.39 (20 years)
Zaria (Maigana)	—	0.84	—	—	7.88	7.24	9.99	8.05	9.91	0.38	—	—	44.29	43.33 (27 years)

APPENDIX IV

INTAKE AND OUTPUT OF STUDENTS

Year beginning 1st of April	Number of Students Recruited Each Year	i. Agricultural Assistants Course	ii. N.A. Junior Course	iii. Total
1932	3	5	—	6
1933	3	5	—	6
1934	3	5	—	6
1935	—	—	—	—
1936	—	—	—	—
1937	—	—	—	—
1938	—	—	—	—
1939	—	—	—	—
1940	—	—	—	—
1941	—	—	—	—
1942	—	—	—	—
1943	—	—	—	—
1944	—	—	—	—
1945	—	—	—	—
1946	—	—	—	—
1947	—	—	—	—
1948	—	—	—	—
1949	—	—	—	—
1950	—	—	—	—
1951	—	—	—	—
1952	—	—	—	—
1953	—	—	—	—
1954	—	—	—	—

APPENDIX V SUMMARY OF HERD RECORDS FOR YEAR 1953-54

Breeds: White Fulani and Sokoto
Station: Shika, Zaria (Nigeria)

Average Rainfalls 42.77 inches in 79.50 days
Mean Annual Temperature: Approximately 77.9

1	2	3	4	5	6	7	8	9	10	11
Total No. of Adult Females in Herd at 31-3-54	Average Out-put Milk per Cow per Annum	Lactation Record in Lbs				Average Butter-Fat percentage	Average Butter-Fat Yield	Calving Interval days	Average During Lactation	Daily yield Between Calves
		Number of full time lactations	Average Yield in 305 days	Range in Yield and Days	Average Lactation Period in days					
White Fulani Heifers (in Milk) 23		5	2,673	Minimum 96 in 27	181.8	Butter fat testing not carried out but from experiments in the past a figure of 6½ per cent butter fat is accepted as average for these breeds		380.3	8.24	3.95
W.F. Cows 122		33	3,115	Maximum 4,655 in 358	269.3				9.55	6.76
Total 145	1,811.6	38	3,057		253.4				9.32	6.25
Sokoto Heifers (in Milk) 4		1	1,968	Minimum 687 in 127	305			365.4	6.45	5.63
Sokoto Cows 51		11	3,454	Maximum 4,252 in 305	266.9				10.79	7.89
Total 55	2,063.9	12	3,310		268.6				10.58	7.80

- Notes: (1) Daily recording. (2) Calves weaned at four days.
 (3) Hand-milked cows milked 3x for first three weeks. Machine milked 2x.
 (4) Average ages of heifers at calving are as follows:—White Fulani (12) three years 10½ months.
 Sokoto (1) four years two months.
 (5) Feeding:—Wet Season: Bush grazing plus concentrates.
 Dry Season: Mucuna hay, silage, guinea corn leaves, soya bean hay, bush grazing plus concentrates.
 (6) Lactation figures above based on lactations of cows and heifers which subsequently calved again before 31-3-54.
 (7) Column 11 determined by taking animals whose calving following lactation fell between 1-4-53 and 31-4-54.

APPENDIX VI

NAMES OF PLANTS IN COMMON USE IN NORTHERN NIGERIA

Acha ...	...	...	...	<i>Digitaria exilis</i> (staple grain crop of some hill tribes, particularly on Bauchi Plateau).
Benniseed ...	...	...	...	Sesame— <i>Sesamum indicum</i> .
Cocoyam ...	...	...	...	<i>Colocasia esculentum</i> , <i>Xanthosoma sagittifolium</i> .
Dauro ...	...	...	...	<i>Pennisetum spicatum</i> , transplanted from nursery beds about July-August.
Gamba ...	...	...	...	<i>Andropogon gayanus</i> (and occasionally <i>A. tectorum</i>) a large grass, used in planted fallows and found wild as climax species in much of the Region.
Gero ...	...	...	...	<i>Pennisetum typhoideum</i> , early planted harvested at four to four and a half months
Guineacorn ...	...	...	...	Species of grain sorghums.
Kyasuwa ...	...	...	...	<i>Pennisetum pedicellatum</i> and other small <i>Pennisetums</i> .
Maiwa ...	...	...	...	<i>Pennisetum spicatum</i> : varieties differ from Dauro in being longer season (six months) and never transplanted.
Millet ...	...	...	...	Normally means Gero (<i>Pennisetum typhoideum</i> .)
Neem ...	...	...	...	<i>Melia azedarachta</i> , Linn. (<i>Azadirachta indica</i> A. Juss.)
Rama ...	...	...	...	<i>Hibiscus cannabinus</i> .
Rizga ...	...	...	...	<i>Coleus dazo</i> .
Tamba ...	...	...	...	<i>Eleusine corocana</i> , finger millet.
Tumuku ...	...	...	...	<i>Coleus dysentericus</i> .

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